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TRINIDAD ASPHALT DEPOSITS.

THE "Moruga sands," a bed of sandstones and shales, estimated at 4,000 feet thick, of the Miocene period, contain the primary deposit of bitumen in the Island of Trinidad. The southernmost range of elevated land of the island is composed of these strata, which, according to Wall & Sawkins, form an arch or anticlinal ridge, running east and west entirely across the island. The dip of the rocks along the southern coast varies from thirty to seventy degrees southward. The exposures are of soft or friable material, easily eroded by ordinary weather exposure, by which they have lost a great thickness of superficial material. Old beach lines from four to twenty feet above tide level record the occurrence of a comparatively recent elevation of the coast.

The La Brea region is underlaid by strata of this bitumen, bearing shales and sands of locally undetermined thickness and richness. According to Wall & Sawkins the unconformities of the sedimentary rocks of the island determine three periods of disturbance in the history of the island, the last of which was related to the line of hills and promontories which make its southern range—the field of its asphalt deposits. The principal deposits of asphalt at the lake and in its vicinity are surrounded by strata, which have been much disturbed, thereby establishing changed conditions which admitted an increased rock and water pressure, while a fracture of the strata afforded a ready outlet toward the surface for the thickening bitumen.

The materials of which the strata making this southern range were built are quartzose and calcareous micaceous sands, micaceous shales and clays, detrius of pre-existing sedimentary rocks, mostly

of cretaceous age. The bituminous strata are of Miocene age, as are those of California, and in part, if not wholly, those bordering upon the Gulf of Mexico, from Louisiana to Yucatan.

Without exception, so far as the writer knows, the shales are in a condition of minute fracture, permitting the free percolation of water, and preventing any important pressure from gas confined within or below them. The lake is located at an elevation which is about 200 feet below the highest point of Mont L'Enfer, six miles distant, which may serve as a fountain-head for the underground waters. Thus it is evident that conditions exist at La Brea favorable to the flow of surface water to the freest contact with the bitumens, and thence to the surface through any available opening. Four miles from the lake in a direct line toward Mont L'Enfer is a group of flowing springs of liquid asphalt.

Under these conditions the natural history of the bitumen is simple and evident. It is a reasonable assumption that its hydrocarbon elements have existed as petroleum in the strata from which the asphalt flows, and further that the most active agency for its polymeric condensation has been the oxygen of the atmosphere, which, as stated by Prof. S. F. Peckham, is carried by percolating surface water down into the earth, into contact with the petroleum. Peckham also shows that an immediate effect of this contact is a release through a process of double decomposition of carbonic acid gas and carbureted hydrogen gas, and a condensation of the nascent molecules of hydro-carbon remaining in the bitumen. Probably the hydrocarbon was of animal origin, and has beem subjected to only moderate temperatures at any period of its history. A consequential effect is the flow of the bitumen toward the surface, due to the expansive pressure of the gases, to rock pressure and to water pressure. The deep-lying oils would rise on the water confined in the lower strata, and find an outlet through the over-lying rocks.

The writer believes that when sulphur is present it also decomposes some of the hydrocarbons, producing sulphureted hydrogen gas, which assists the other causes of pressure and upward flow of the bitumen. These influences have operated for a long time, and the transformation has been a progressive one.

The abundance of asphalt in the Trinidad deposit is what pro-

duces the strongest impression upon an observer. A single bed or deposit of 110 acres, the so-called lake, and outlying deposits of possibly 1,500 acres, irregularly disposed as to elevation and connection, both with the lake and with themselves contain possibly two or three million tons of asphalt when refined. All the asphalt, there, commercially available, is in these secondary deposits to which it has been transferred from its primary deposit by ordinary natural causes, as explained above.

The conditions under which subterranean concentration of fluid hydrocarbons are brought about are fully discussed by Prof. Orton, in his geological report of Ohio, for 1890, and his conclusions are believed to be applicable to the Island of Trinidad. Conditions known to exist there admit of the application of Prof. Peckham's theory of the agencies by which the deep-lying oils have been brought to the surface, and co-incidentally condensed into maltha and asphalt. All this is entirely in line of Dr. Wurtz' conclusion, as to polymeric condensation of rock oil into asphalt, who says: "Asphalts and asphaltoids are mainly produced from petroleums, by polymerization of certain constituents of such oils under the influence of the air, or of the sun's rays, or of both, together with the influence of acid, saline or other polymerizing agents incidentally present." In this connection, Dr. Wurtz calls attention to the "ample evidence of spontaneous polymerism of many native carbo-hydrogen liquids, by mere lapse of time, without the influence of other agency than that of temperature."

For several years the writer has held the opinion that the origin of the basin containing the lake proper, as well as the valley of its drainage, are to be explained without reference to phenomenal occurrences of any kind whatever. He believes that these depressions were formed by sub-aerial erosions, as have been most valleys of drainage everywhere. The refilling of such valleys of drainage has been of frequent occurrence generally, and is now taking place on a vast scale in many parts of our own country. Under common conditions, a valley of drainage is eroded in depth with much greater rapidity during the period of its earlier history, and there is thus provided a steep descent for all lateral streams, which obtain in this manner the power to excavate with increased rapidity their separate valleys. As these lateral branches increase, the area of

erosion is increased and the quantity of eroded material is enlarged too rapidly for the main stream to remove it, and its valley begins to refill. This summary of the course of events may be stated as a brief history of nearly all the rivers of our country, with all their branches and minor subdivisions up to the little rivulets near their fountain-heads.

The valley of La Brea was undoubtedly formed by the action of the waters flowing through it to the sea. The rocks are very friable and incoherent, and weathered readily, thus forming in this case, as it generally does, a wide dish-shaped depression at the summit where the water gathered to form the head of the stream. Its deepening channel cut down into some bitumen-bearing strata, or opened vents from the same, probably doing both, so as to receive into its depression the outflow of malthas from below. Thus was brought about a more rapid action upon the imbedded hydrocarbons, a larger production of gas, and a more voluminous discharge of maltha into the valley. The maltha flowed down the slope, a distance depending upon the temperature, and the rapidity with which it hardened from exposure. Soil washed from the sides of the valley formed beds in its more level reaches, and at times these were overflowed by subsequent outflows of malthas. So by irregularly acting natural causes, the valley became filled; and the bitumen at the upper part of the valley became impounded, and constitutes what is called the Pitch Lake.

Visitors to the Pitch Lake sometimes advance theories explaining the origin of the bitumen which are inconsistent with the conditions of attending occurrences at that place, and of similar phenomena in other places throughout the world. The greatest service of Mr. Richardson's sixth annual report, in this connection, is his reprinting of Mr. Manross's description of the lake in 1854.

The writer is yet to hear of any phenomena in the vicinity of the Pitch Lake that may reasonably be referred to heat agencies, such as attend even the mildest forms of volcanic action. The basin of the lake and the valley of its drainage down to the sea are, he believes, parts simply of an eroded valley, similar to hundreds of others at places of bituminous outflow in California and elsewhere. The greater rainfall in Trinidad, compared with that of the region of the Coast Range, in California, accounts for the

greater outflow of bitumen in the vicinity of the former. In California there is a visible increase of the flow of maltha from its springs, in the rainy season.

The quantity of refined asphalt to be obtained from the crude materials exposed in and near the lake may be estimated at a maximum as follows: Thirty feet of depth at the center of the lake, yielding 2,000,000 tons; in the land deposits possibly as much more, making in all 4,000,000 tons. Actually the gross amount may not exceed one-half of this.

The comparative importance of the deposit is due to its accessibility. There are two or three similar deposits in the Argentine Republic, located beyond the limit of economical transportation.

As to the primary source of such a vast quantity of asphalt, we repeat that it undoubtedly lies in the immediate vicinity, deeply buried in the earth. The possible capacity of asphalt or petroleum-bearing strata to yield the material is not often fully considered; hence the following calculations and statement may prove of interest:

Beds of oil-bearing rock covering hundreds, even thousands, of miles of area, of varying thickness, sometimes amounting to hundreds of feet, may contain ten, fifteen or twenty per cent. of bitumen. One square mile of such rock has, for each foot in depth, 27,878,000 cubic feet contents. Ten per cent. of this, as a theoretical yield, gives 2,787,800 cubic feet of bitumen, or over 80,000 tons; for fifty feet of thickness, 4,000,000 tons. One may vary the estimate by changing the area, the thickness of the strata and percentage of yield, and so find an estimate which will appear reasonable to him.

There is abundant specific information to the effect that there has been in the past a large active overflow of asphalt from the lake, which was visible in 1854, being at the surface of the ground. A description of this phenomena as witnessed at the time is given in the account of the lake published by Mr. Manross, *Am. Jour. Sci.*, 1855. If active overflow has been in operation in recent times, it has been beneath the mass constituting the present surface of the deposit. This is stated with admission that there is still probably an exceedingly slow movement of the hardened surface deposit, one too slow to be properly designated as an effective one. The thin-

ness of the soil covering the asphalt near the lake is possibly an indication of this. With rapid movement of the asphalt, the earth which has been washed over it by rain, and also in part resulting from the destruction of the asphalt by fires and atmospheric decomposition, would have been carried away, leaving a bare exposure of the asphalt. As the asphalt below the surface is softer, it necessarily is more subject than the surface material to a slow viscous movement, due to gravity and pressure. If there are tar springs beneath the land asphalt, a matter yet undetermined, they will materially contribute the same result. It is difficult to understand how a viscous solid subject to the heat of the tropics can possibly lie still, if resting upon a bed of tar and on sloping ground. Hence it is legitimate to assume that if the tar or a soft asphalt exists beneath the surface land asphalt, the latter has some flowing or sliding movement down the hill; if there is no underlying tar springs, then all the asphalt has been necessarily derived from the lake. So, view it as one may, the conclusion is forced that substantially the land and the lake asphalt are from the same subterranean and fountain source.

Taking the position in argument that the asphalts of both deposits are lake asphalts, the one question to be considered is whether the older, the land asphalt, is less suited for making pavement cement than is that now taken from the lake. It seems evident that the hardened crust of the lake, found near its borders and around its many islands, is substantially like many of the surface land asphalts. That found near the center of the lake is softer than the others, and the question involves a comparison of asphalt from the softened mass near the center of the lake, and the best land asphalt, dug from beneath the hard surface deposits of the land. The comparison being of like grades from the two deposits, and of asphalt in shipping quantities, not hand samples.

It is believed to be indisputable that in each and all of these respects there is absolutely no difference between land and lake asphalts. The asphalt may be considered probably as an alloy of differing hydrocarbons; certainly that is what the paving cement may be called. Purely and simply, it is an alloy of the asphalt and the residuum, or other tempering material; and, as you restore any lessened element of an alloy, as brass, spelter, etc., so in an asphalt

paving cement, if it becomes too hard from loss or change of oil, you restore the softness of it by adding or replacing the lost ingredient.

All discussion of the comparative merits of crude, and even of refined asphalt, used in paving, is not very important. These materials are not used directly in paving. They are always subjected to treatment in preparing cements, and the qualities of crude, and also of refined asphalts are much changed thereby. Pavements are made with asphalt cements, and not asphalt either crude or refined. The real question is, which is the best cement? *D. Torrey.*

DOLPHUS TORREY was born November 30, 1833, in Sherburn New York. Both his paternal and maternal lineage is traced back to the earliest settlers of New England. He had the advantages of country schools only and began business life at fifteen years of age by learning the trade of molder in an iron foundry. He went to Davenport, Iowa, in 1854, and was soon after employed as passenger agent by the Pennsylvania railroad. In 1861, he enlisted in the Cincinnati Rover Guards, for the three months service. Afterwards he raised a company at Davenport, Iowa, Company D, Twentieth Iowa Infantry. After the war he accepted a position in the general office of the Pennsylvania Railroad Company, at Philadelphia. Subsequently he had charge of the sleeping-car service of that and associated roads, until appointed Chief of Transportation United States Centennial Commission, 1876. In 1887, he entered the service of the Warren-Scharf Asphalt Paving Company, since which time he has been interested in asphalt paving, being now with the Trinidad Asphalt Refining Company. His life has been that of a student, with strong inclinations toward the physical and natural sciences, of which geology has been most favored by him.

Two years of his time has been given to personal investigation of the asphalt deposits of this country and Mexico, and laboratory investigations of samples of asphalt gathered by himself. He made one or more trips to Utah, California, and the Huasteca region of Mexico, thereby gaining the information which forms the basis of his present opinions concerning the origin, accumulation, and properties of asphalts.

BURNED CLAY FOR ROADWAYS.

I CONSIDER burned clay, when properly prepared, very good material for residence streets, providing all streets leading to it are improved. Mud carried from an unimproved street will soon pick the clay up and carry it off. It was first used in Kokomo at the intersection of two well traveled streets, covering only about forty feet square. The clay was of good quality, burned hard. In the center it stood all right, but near the foot crossings, where the streets leading to it were muddy part of the time, muddy wheels would pick up some of the material near the crossings and carry it off. It was not

long until there was quite a basin near the crossings. The street that was to be constructed of burned clay was never received, it being a very poor piece of work. The clay was not good, having in it quicksand, gravel, white and yellow clay, beside the top soil, and then not burned hard enough. The roller used was a light one, only weighing five tons. It should not have been less than fifteen tons. The surface of this street in wet weather becomes very soft, and wheels cut in from one to three inches. During dry seasons it does very well, but a dry weather street is not what we want.

I can not give proportions, but burned clay is made by first laying a long row of kindling wood on the ground, with enough slack coal added to make a good fire. This is then covered with good, pulverized brick clay to a depth of a few inches on the sides, care being taken to leave a draft for the fire; it is then ready to light. The fire should be under good headway before adding more clay; then put on in alternate layers of clay and slack coal. After the top is covered it should be penetrated every few feet with a sharp-pointed crow-bar, or the fires will smother out. This should be done as each layer is added. When it is of sufficent height, say about five or six feet (to insure good burning), it should be watched all the time to keep the holes open. After it is burned out it is ready for use.

Burned clay, like all other material for street building, should have a good substructure. That being faulty, so will the superstructure be.

Care should be taken to provide good drainage before material goes on by putting in a red tile on either side, about thirty inches deep. The sub-grade should be rolled with a fifteen or eighteen-ton roller before putting on the burned clay, which should be put on in four-inch layers, each layer to be thoroughly rolled with the same roller used on the sub-grade. Three such layers are sufficient to make a good roadway. Water will not stand on it, nor will it support vegetation. To a certain extent it is springy, almost noiseless and very easy on a horse.

I consider it, when well made, desirable for residence streets or parks, but not best for heavy traffic. It can be constructed for about $1.20 per square yard, exclusive of grading and curb.

A. W. Smith.

A. W. Smith, city civil engineer of Kokomo, Ind., was born in Miami county, Ind., June 19th, 1858, where he was raised and educated; afterward teaching school awhile; always with a decided taste for mathematics, but none for teaching. He abandoned that in two years and locating at Kokomo, Ind., in 1883, he soon became assistant city civil engineer, which position he held until June 3d, 1889, at which time he was elected city civil engineer. Since then he has been very busy. All his practical work has been done there.

CEMENT SIDEWALKS AND HOW THEY SHOULD BE MADE.

In the last five years the city fathers of many towns of the central part of Illinois have adopted an ordinance wherein all pavements for sidewalks, in certain parts of the city, "are to be cement." This is a most worthy ordinance. Cement walks are more inviting to the stranger, and more appreciated by the owner, than any other kind. They are always clean, easy to walk on, more pleasing to the eye, and give a beauty of finish to streets and boulevards which seem to blend with the property and all surroundings. Cement walks, when made properly, are even more durable than inferior qualities of lime and sandstone. All contractors should guarantee them for ten years. The nature of these walks is that the longer they lie the harder they get, while natural stone will eventually shell off, show water holes, become rough and decay to a certain extent. The question of sidewalks is a very important one in the permanent improvement of cities, and it is to be hoped that the merits of cement for sidewalks will be investigated more.

Cement walks are more successfully made from crushed granite and Portland cement, which is called "granitoid," and is classed as first-class work. The success of granitoid in public improvements in the city of St. Louis, Mo., has been remarkable. These walks are to be seen in all the principal streets of the city, and miles of such walks now flank the public parks. In the last two years the alley drive-ways, in the heart of the city, have been paved with granitoid, and the heaviest loads pass over it constantly without injury to the pavement.

Portland cement and clean gravel and sharp sand, mixed up in

a plastic condition, spread out, troweled and finished, is considered just as good a walk as the granitoid work, excepting its richness of color. It is not, of course, as hard a substance as the hard granite would produce, yet in small towns, or in large cities where the travel is not too great, it answers the purpose just as well as the first grade, and, being made with such cheap material, is brought within reach of nearly all property owners, as the cost is at least 40 per cent. below the granitoid work.

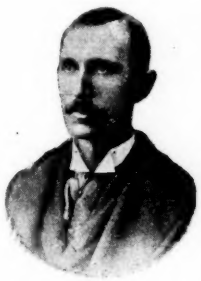
In making a cement walk you must first have a foundation of cinders, gravel or sand of not less than eight or ten inches deep, which must be rammed and tamped and thoroughly wet, so that they will pack and the foundation will be solid; second, the contractor should lay out his work so that the inside line of his walk will be the highest, which will carry the water off quickly; third, keep the walk as high as possible above the level of the ground. If the contractor is making his walk four inches thick, then the inside of the walk should be four inches above the level of the ground on the inside line. By keeping the surface of the walks three or four inches above grade line, it always keeps them cleaner and drier and does not retain dampness as much as if the surface was about even with the grade line.

The specifications for cement walks vary considerably. In granitoid, the grouting is four inches thick, composed of three parts of coarse crushed granite and one part of Portland cement, dry, mixed over at least three times before wetting, and immediately spread out; while in the second grade work six parts of clean gravel to one part of Portland cement is sufficient. The blocking off of the work is important, and is the secret of making a successful walk. It must be made so that the frost will escape from under it, or it is bound to heave and crack. This is done by making a joint in the grouting, and another joint in the topping or wearing part, exactly in the same place as the joint was made in the grouting. These joints must not be made too far apart. The blocks should be as near square as possible. In a ten-foot walk, then, the blocking should be made five feet square. In a twelve-foot walk they should be made four feet square. These joints are a protection from the frost, as it will escape from the joints and not crack the walk.

Only Portland cement can be used for sidewalk purposes, and

there is only one way to use it successfully—that is to float it in the grouting, so that the water will come to the surface, and immediately pour on the topping and work it on the same principle, bringing the water to the surface of the walk. It adheres to the other material, and will make a solid stone.

There is no need of chemicals in making cement walks, as pure granite, gravel, sand and Portland cement are the cleanest of materials and are not subject to decay. *E. L. Martin.*



E. L. MARTIN was born in Decatur, Ill., in 1860. He started a coal yard at the age of twenty, and a few years after he added to his business contracting in cement sidewalks. He is the leading contractor in Central Illinois for cement walks, and has done much in the way of beautifying cities. He was the first to introduce cement walks in the leading cities in Central and Western Illinois, having laid the walks around state and public buildings in the cities of Jacksonville, Champaign, Springfield, Quincy, Peoria, Bloomington and Litchfield, Ill., Hannibal, Mo., and Paducah, Ky. In many other towns he has done work. He has a branch of his paving business in Springfield, Ill., and is also interested with William Shuler, of Ottawa, Ill., in the paving business. He is also president of the Macon County Coal Company.

WOOD PAVEMENTS IN PARIS.

IT is a surprise to an observer to see the amount of wood pavement being put down in Paris. A pavement which is literally worn out under four years' traffic on Boulevard des Capucines has recently been replaced by another. Demands are made in other sections of Paris for wood pavement. Why? is asked. One reason is that it is relatively less noisy; and, again, they have not had the extended experience with it that has been common to some other cities, where it is now received with less favor. People who live on the boulevards are disturbed by the noise of the other pavements. The wood pavement, while not greatly less noisy, is, in a measure, less objectionable, and for that reason is received with more favor. In Paris these wood pavements are splendidly cared for. Within three months from the time they are put down, inspectors may be seen passing over them, taking out the bad blocks and putting in old good ones. This operation is continued until the pavement is entirely worn out. In truth, there is never a time in

its history when it shows itself to be in a state of decay or neglect. It is always a relatively smooth pavement. It ceases to be used when the blocks are worn down. Some of the blocks recently removed from the boulevard named were worn down within two and a half inches of the cement base on which they were laid. This was to be noticed at the street crossings where there was not only traffic of the boulevard, but that of the street which crossed it.

In Berlin the block pavement seems to be in a greater state of neglect. The authorities there do not look on them with favor.

Louis H. Gibson.

MAINTENANCE OF ROADS IN FRANCE.

IV.

REPAIRS.

THERE may be two classes of repairs: one when a road has been neglected or under the care of an inexperienced man for a short while, and the other when a road has been totally abandoned for a number of years.

In the first case the damage is caused because the mud has not been cleaned or because the spreading of new stones has not been done intelligently, or because those newly spread have been neglected.

When a muddy road is cut up by ruts, the first work to do is to clean it, and often it is found that the ruts were only apparent, the ridges on each side being nothing but mud and a few loose stones, and only a slight depression exists in the road-bed proper that will often disappear under the wheels when they will cease following the same track. If, however, the depressions were deep enough to be too inviting for the wagons to follow them, it would then be necessary to fill them with stone, not above the level of the surface, but rather below, in order to prevent the wagons from cutting new tracks right alongside of the filled ones. Should wagons attempt to keep too close they would fall back in them every once and a while, and by that means keep the surface level.

If ruts were filled with stones before the mud is cleaned out, it would be a waste of material and of time, because new ruts would

be necessarily formed parallel with the first ones, and the road be just as bad after as before.

Of course if a muddy road shows ruts when cleaned, it will also show many depressions here and there that will need to be attended to, as I explained before; and, moreover, when a road has been so neglected through carelessness or lack of judgment of the "cantonnier," it will pay the engineer to send a good man in his place, because that part of the road needs extra precautions that the man who has allowed it to come to that point will not be able to take.

There are other causes that will bring a road out of repair. For instance, a "cantonnier" seeing one side of the road lower than the other will cover it with new material. Then the wagon will naturally make for the other side at the same place, and soon cut ruts on the best side and never attempt to run on the new stones as long as the other side is practicable at all. If such work had been done the only remedy would be to take up those stones and raise the low place by the patch process. The same is true if the whole width of the road was covered with new material on any length. Wagons soon make a track and never leave it. So unless the road is provided with a convenient roller extensive filling can be done in no case whatever.

But when the road has been entirely neglected for a number of years and it becomes necessary to bring it to a good state of repair, the first method that presents itself is to pick up all the stone, screen it clean of dirt, break it to regular size, level the road-bed like for a new road and replace the macadam by adding enough new material to give it the proper thickness.

This simple process will certainly make a good road out of an old worn out one at as little cost as may be expected. It has a grave inconvenience for roads with large traffic; in fact, the picking up of stones, the leveling of the road-bed and the spreading of the material over it will occupy a comparatively long period of time, unless money enough has been appropriated to do the whole in one season. In most places but one track will be left open to traffic and if the weather should be damp and rainy, people would soon regret their old rough road.

To avoid this inconvenience another method is used. First soundings are made to ascertain the thickness of the macadam and

if it is not too thin the top is cleaned out of all loose stuff, stone or dirt, then the bumps are picked down and the holes are filled and in a short while the surface may be made smooth. Though the whole macadam may be thinner than it ought to be, it is only raised by a continuous patch work without materially obstructing the traffic. If the bottom had been made of larger stones, as in the Telford system, and their tops would protrude above the surface, it would be advisable not to disturb them, but simply break off the protruding points. This method is slow, but general and progressive. With, of course, an adequate increase of labor, the road keeps growing better from the very start without, like in the first mentioned method, passing through a worse state to become better.

It is plain, however, that if any important changes were needed in the grade of the road to be repaired, the first method would necessarily have to be employed in order to raise or lower the road-bed before spreading the new material.

This covers about all cases of maintaining a good macadamized road, yet I think it would not be out of place to say a few words about their thickness. In France, where roads are continually taken care of, it is admitted that from eight to nine inches thick of well made macadam is able to bear the heaviest traffic, that the road does not need to be crowned too much on the center, one-half a foot raise on a road twenty-five feet wide being ample enough. Water does not remain on a level, smooth surface and the wagons are not so inclined to exclusively keep the center and the width of the tires are by law regulated in proportion with the weight of the load hauled.

Arthur Lagron.

ARTHUR LAGRON, C. E.
See biographical sketch in January number, 1893, page 17.

THE EVOLUTION OF THE BRICK MACHINE.

My earliest recollection of a brick-yard was the abandoned one in my father's meadow, a *much burnt monument* in the shape of "stuck arches," the "stick" extending high above the "running courses."

All traces of a brick-yard had vanished except this monument

to the skill of the burner and the clay pits, which made skating parks in winter and most admirable fishing ground for "minnows" and "sun-fish" in summer. I remember that these same fish were wonderfully skilled in "taking the worm" from "the bent pin" and avoiding being "landed" by the beautiful white cotton string secured from the wrappings of the last purchase of sugar made by my mother. If my recollection be correct, some of the "sugar" went with the string, but not to the fish.

The next investigation into the art of brickmaking was to the yard on a neighboring farm, that afterwards became the country-seat of our much-loved poet, Bayard Taylor, and where he built the beautiful "Cedar Croft" in after years.

At this enchanted ground the young investigator found one shed, probably one hundred feet in length, of low construction, made of rough round forked sticks set in the ground, with the crotch up, in which laid sapling poles, supporting boards of various thickness, widths and lengths, some sagging to a graceful curve and others endeavoring, by their straightness, to keep up the dignity of the structure, as a drying shed.

In the clay pit I found what proved to be a human being with arms bared above the elbows, feet and legs without covering below the thighs, bespattered with mud from his eyes down, the coating increasing in thickness as it reached his heels.

This "artisan" was tramping in an oven-shaped mound of soft mud up to his knees, and with all the diligence attributed to the beaver.

Out in the glaring heat of a mid-day summer's sun stood a man at a low table with a square (?) box made of wood, which he alternately dipped into water, then into sand, and finally filled it with a portion of the tramped clay from his partner's mound—the brick was thus finally "molded" and borne of by the diminutive "apprentice" and dumped in a misshapen mass upon the leveled ground. The "molder" had eyes, but they were only visible by their brightness through the two upper cracks in the dried coating of clay and sand covering his face.

In after years, when childhood had given way to boyhood, in teens, an older brother, who was casting about for a business (having grown tired of the "whirr" of the spinning-jenny which he ope-

rated in our father's factory), visited a neighboring city to investigate and witness the trial of a wonderful invention for the purpose of making brick by the "dry clay process."

This machine had the usual number of cog-wheels, cams, toggles, levers, abrupt movements of large masses, etc., all to go through their evolutions for each brick produced.

A boy that had grown up in a woolen mill, and ran a saw-mill, needed no long investigation nor a second visit to determine the impracticability of such devices under the abrading process and influence of the clay.

Returning home disabused of the idea that he had found the long sought for desideratum, he said to me, "Cy., I wish you would make me a brick machine."

"Cy." commenced.

After studying the then prevailing methods of making brick in vogue then in the vicinity of Philadelphia and carefully noting the various processes, and visiting numerous locations where other processes had been tried, a systematic course of experiments was entered into to determine a practical, if not the best, process by which brick could be produced by machinery.

It was soon apparent that a "machine" which molded brick only was of little or no practical value, because the molding alone was but a small part of the labor and expense attending the production of brick. There was the preparation of the clay, by "winter digging," the mixing of the various qualities, the tempering, "off-bearing," "drying," "edging-up," and finally the taking in and "hacking under cover," if the storms permitted them to reach a proper condition for the latter processes; if not, then they were shoveled back into the pit to be "ground over," and all the subsequent operations repeated.

Next the "dry clay process" was examined into, with the hope that it offered a more encouraging outlook for the youthful mechanic and inventor.

Some samples of fine, tenacious clay were procured, dried and pulverized (a process costing far more than to make the wet material into brick at once). So dry and fine was this clay that by throwing a handful of it into the air it floated off and you couldn't tell where it fell.

This material, thus prepared, was put into a round mold of great

strength, turned out true inside in a lathe and furnished with a plunger, snugly fitted. In turning out the mold the lathemen withdrew the turning tool without easing up the cut, thus producing a fine groove throughout the length of the mold.

This mold, being filled with the finely pulverized and dry clay, was put under a hydraulic press of great power and submitted to a pressure of 600 tons, or over 120,000 pounds to the square inch.

What was the result?

Notwithstanding this clay had been in a steam-heated room for over three months this enormous pressure caused the water to flow from it all around the plunger, and at the fine groove (made by the withdrawal of the turning tool) the clay issued in a stream as fine as a human hair, curling in all directions like a thing of life.

This brick was burned and upon examination after burning showed each granule of clay in its primitive shape with fine fissures between each, clearly demonstrating the want of thorough incorporation and adhesion of the various particles.

Upon submerging this round brick in water it absorbed 5.55 per cent. of its weight, notwithstanding it was "hard burnt" almost to vitrification.

This demonstrates four things:

First. To dry clay perfectly is impracticable, if not impossible.

Second. That no reasonable amount of pressure alone will cause the various particles of ordinary clay to adhere and form one solid, homogeneous mass.

Third. That argillaceous and sandy material so put together and burned was a great absorber of moisture.

Fourth. That a brick so made, burned and soaked would not stand "freezing and thawing," but would crumble to dust, and each granule of sand and each particle of clay remain in its primitive disconnected condition and could be distinguished in the blackened mass.

Discouraged by the investigations into the two proposed extreme plans for a process upon which to construct a machine, an intermediate process was conceived of, and experimented upon, with gratifying results.

By working the clay as nature furnished it—with the natural moisture in it—all time expense of drying was avoided.

By mixing and tempering in a stiff consistency the granular

part of the material was thereby incorporated with that of the plastic, and a thoroughly homogeneous compound produced. When forced to shape, "molded," in this stiff condition, the bricks could be at once handled, wheeled to sheds, and "hacked up" out of the weather, thus avoiding the expense of floors, "edging-up" and "taking-in." Samples made by this process stood all the tests of strength, absorption, frost, etc., and it was determined to proceed to construct a working model upon this general principle, that is, which is now known as the stiff tempered clay process.

But the young mechanic had much to learn yet. The power required to temper and mold "stiff clay" was not in the books.

Experiments had to be made to get the necessary data from which to construct even a working model upon this principle.

The power required to temper and mold this stiff clay was so far beyond that which any machinery then in existence for working clay would stand, that the whole field had to be explored from the beginning to the end, and notwithstanding all this the first model machine was continually breaking down, or sticking fast, or refusing to turn.

When it broke down the parts breaking were strengthened and improved in design, and when it "stuck fast" the reason was examined into and finally a working model was produced which tempered its own clay, molded the same into a continuous bar one-third the thickness and breadth of that of a Philadelphia brick. This bar was severed into "brick lengths" by an automatic cut-off, a knife on a wheel, whose speed was regulated by the flow of the clay from the die, and the brick so severed off-borne on an endless apron, ready to be hacked.

The miniature brick produced by this model were burned and examined by expert brick-makers, masons and scientists. Their strength was tested and all kinds of critical examinations made, particularly the incorporation of the various materials or various particles entering into their composition. I remember one old Friend, a practical brick-maker, who scanned closely the texture, from under his broad brim, and examining closely a piece, not larger than a pea, said: "W-e-l-l! it is well tempered, but I don't understand

why the 'skin' is so fine and so much richer in color than the rest of the brick."

Here was something that had escaped our notice entirely.

Upon examination of these toy bricks, under his guidance, we saw that the die surface of the brick was exceedingly fine, smooth and of a much richer cherry-red than the body of the brick.

No sand having been used in molding it could not be attributed to the superior coloring of the sand, besides it was much finer and smoother than the "skin" produced by our finest Philadelphia sand.

Farther experience taught that this result was due to the action of the machine upon the clay by moving the particles through and between each other, while under great pressure. The finer portions of the material were forced into the interstices of the larger ones, and to the surface between the coarse particles and the die, thus thoroughly cementing together the granules of sand and producing a "skin" of the finer and long portions, which "color" in burning, and thus producing that effect so much prized by the manufacturers of "red brick."

Knowing that to embark in the construction of a large machine for the manufacture of brick meant much labor, time and the expenditure of much time and money, and that it wasn't to be entered into without due consideration, an invitation was sent to my father, then well advanced in years, to come to Philadelphia and see the model machine. This he did, for he was a great lover of machinery, a born mechanic of no mean order, and had the success of his "boys" at heart.

He was taken into the room where the model was and it was set running; he looked the machine over carefully without uttering a single word. No explanation was needed by him, he reading from the machine faster than we could describe it. Then he went to one side and took a seat on a tressel, watching the machine run for more than an hour. Not a question asked; not a word uttered, but a silent examination from the beginning of the operation of feeding the crude clay into the machine until the finished brick reached the end of the off-bearing apron.

Presently he arose and said: "Well, boys (we were men grown then), I will risk all I am worth on that machine."

"The die was cast;" when he approved there was no longer

hesitancy, but to the construction of a large machine at once, notwithstanding dollars were scarce, and the mutterings of the coming "unpleasantness" were heard in the distance, for this was in 1860.

This was the first completely automatic machine ever produced, performing all of these operations in one continuous operation by one completely embodied mechanism. A recent and thorough search into the 24,254 patents issued by the United States Patent Office, and those of foreign countries, for brick-making machines, fails to show any complete automatic practical machine for producing brick or tile upon this principle prior to the completion of this model machine. This machine was conceived and constructed in the latter part of 1860. Working drawings were made for a large machine (large indeed it was, a single piece weighing over 5,000 pounds), calculations were made from the best data we had gathered from the numerous models we had broken down for the strength and power required, and the machine constructed, erected and tested in the shop.

Our shop was then in the second story of a building at Seventh and Cherry streets, and the owner was afraid it would break his building down, the complete machine weighing over ten tons.

We stalled his one hundred horse-power engine, smashed down spur wheels of enormous strength, twisted off heavy shafts, and parted bolt after bolt before we learned the properties required for the machine, and the power required to temper and mold stiff clay.

Finally the machine worked—producing thirty brick per minute.

An exhibition was given to which our numerous friends and the brick-makers of Philadelphia were invited.

Our friends were delighted, but how about the other class, from whose pockets we hoped to extract the thousands of dollars we had expended in this enterprise.

Many objections were urged by the practical brick-maker, the "hand men" as they all were at that time. There is "no sand on them," "their ends are rough," "they are of unequal lengths," "the clay is stratified," "the clay is laminated," etc., and according to the general opinion the machine was "no good."

Discouraged by these opinions, but not disheartened, the objections were carefully studied and all were overcome except the "rough ends" and the "lamination" of the clay.

The cut-off was so improved as to meet practically the objection

of varying length. A sanding device was invented, whereby a coating of sand was thrown over the freshly molded and moist brick; but all efforts to eliminate the "stratification" in the clay were unsuccessful except in degree. These changes and experiments consumed another year. The excitement of a civil war was upon us, labor was becoming scarce and rapidly increasing in cost. The brick consumer became less fastidious and we concluded that then was the time to make an actual test, in the yard, and the only way to demonstrate the practicability or impracticability of manufacturing brick by this then novel process.

Knowing full well that to put the machine into an already established brick-yard where we could not have full and absolute control would probably lead to failure, an abandoned yard at Pea Shore was rented, the remains of an engine bought and exhumed from under the sand that had drifted over it for years, the machine erected, and all was ready for a final start.

"Why, Chambers! you are not going to start your machine in that 'graveyard' of brick machines, are you?" Every machine ever tried in that clay was a failure (and they were many), hence the name "graveyard."

We started our machine in the early part of '62. It ran beautifully for about fifty seconds, producing nineteen bricks, when a crack was heard, the machine ceased to revolve, and all was silent except the engine; it, being relieved of its load, "ran off." My brother counted the bricks so made in a mournful tone: "N-i-n-e-t-e-e-n b-r-i-c-k-s, and each one cost over one hundred dollars." While he was counting the cost of the bricks I was getting out the broken parts of the machine, and the next train bore me to the shop for a new and heavier spur gear. One was selected, guaranteed by the founder to drive any "mud squirt" that we might ever build. Yes, indeed, that would turn the "sausage stuffer."

At this critical period I would rather have given up my left arm than have had this accident to happen.

Soon the damage was repaired and the machine started, running for the balance of the season, the bricks drying and burning, notwithstanding the many prophecies that they would "go to pieces in the kilns."

Our first order for brick made by this process was from a friend

for two small houses; the second for 2,000,000, with the stipulation that, at the option of the owners, the walls were to be measured, if the count was not satisfactory, and settlement made accordingly. Then the new development appeared relative to the quality of these brick. They overran, by measurement, the count, about ten per cent., owing to their superior strength, and consequently little or no waste.

The "lamination" (which was so much feared, criticised and condemned at first), proved to be one of great merit, adding great strength to the brick crosswise.

Clay, like many other materials, arranges its particles lengthwise while being rolled, drawn or forced through dies, hence brick so made were much stronger in cross section than those of homogeneous structure.

The first full-sized machine was replaced at the end of the season with one of improved construction, which has been in constant use ever since. Thirty years is no mean life for any machine, much less for one working in such abrading materials as clay and sand.

Now, all our troubles were over, and we only had to build and sell machines; but, alas! the devices which worked so satisfactorily in one bank of clay refused to operate in that from the other side of the fence.

The man who thinks the inventor has easy work and reaps all the profit is much mistaken.

Every variety of clay presents a new problem. A process or a machine entirely successful in one material, may prove an utter failure in another. To adapt the machine to the various qualities of clay throughout the civilized world has been the work of over thirty years, and the task is not yet completed. Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, the Carolinas, Florida and Louisiana, each have their peculiar qualities of clay, to say nothing of our long list of Western States.

The clay of Duluth, Minnesota, was a "sticker." It is said of it that if a man goes into the bank to dig, his spade sticks fast, and in the effort to get it out he himself is entrapped, and another man is required to get the first one out. A machine, eminently

successful in a hundred different clays, was an utter failure at Duluth.

Each failure, however, was but a spur to renewed effort. The nature of the new material was carefully studied, the machine modified to suit its requirements, and, strange to say, every change so made was for the betterment of the machine for all the clays it had previously worked.

The first complete automatic expressing brick-making machine (producing about thirty thousand brick in ten hours) was a cumbersome, heavy affair, and of too great a capacity for the many then would-be customers. A machine of less weight and cost was much sought after and we set about to produce one small and inexpensive for the smaller towns and villages, and proposed to call it the "Village Brick Machine."

In the designing and construction of this machine all the little points learned by experience were embodied, the exact proportions of each part with another carefully studied and calculated, and a machine produced that instead of being of small capacity nearly trebled the output of its larger and older brother.

A working model of this machine was exhibited at the Centennial.

Not to be thus baffled, a third effort was made to produce a machine of small cost and capacity. Taking advantage of the still greater experience in clays from various parts of the world a machine was prodnced still more complete in detail and reliable in operation, but in capacity still far beyond the requirements for the "village."

A fourth effort resulted in the production of one sufficiently meager in its output, but so simple in construction and "kind" and efficient in operation that its novel features are accepted to-day for the production of the best quality and the greatest quantity of common brick.

Taking the best parts of these three later machines and embodying them into one grand whole, we have what is known as the "B-CD," each of its predecessors being styled in its turn the A, the B, the C and the D.

Thus you see how our most successful machine, the B-CD, was evolved.

During these years many other inventors and experimenters were

engaged in efforts to improve the ceramic art. No better evidence of this can be adduced than of the 24,721 patents issued by the United States Patent Office alone for improvements in machinery and kilns, to say nothing of those of foreign countries. Three hundred and twenty-three patents were granted in the United States for screw machines, 442 for reciprocating, 305 for rotary, 394 for tile machines, and 467 for improvements in kilns.

It is no small task for the brick-maker to select the most efficient machines and kilns for manufacturing brick from the above list. Indeed, not one in a hundred of them are at all practicable, and most likely that one is so poorly constructed as to be wholly worthless.

Certain processes are well adapted for one material while wholly unfit for another. One clay, say the natural prepared "malin" of the Mississippi and other rivers, is adapted to the dry clay process; while another, the tenacious argillaceous material, requires an entirely different mode of working. One clay will require and stand much tempering and be improved thereby, while another will be ruined if over tempered.

Beware of the man whose machine will work all clays.

The price of a machine has but little to do with its selection, the very best is poor enough. A machine that will save its cost in from three to six months is not dear at any price. To-day the best machines are fitted up with the greatest accuracy, of the very best materials, replete with all the little conveniences for their care and preservation; all parts made to interchange, and those in contact with the abrading materials easily and cheaply renewed.

One machine may look just like another to the brick-maker unskilled in mechanics. Yet one is complete in detail, working "day after day, week after week and month after month," without interruption, while the other is constantly being stopped to fix this, that and the other, and at the end of the month not half the rated output is realized. The best evidence of the value of an invention is its piracy.

In the selection of machinery for the preparation of clay, making of brick and burning, it is well to throw the risk of a trial upon the parties selling. Let them be at the expense of erection and testing an untried machine or kiln in a new material, and you make

your decision after making and burning say half a million of brick by the new devices.

Probably nine-tenths of the brick consumed in the United States to-day are made by machinery, and what is the effect of this change upon the brick-maker? In the early part of this paper you had a "word-picture" of the "old-timer" besplattered with mud from head to heels, working like a beaver to produce, during the warm months, a few misshapen bricks, which he disposed of as best he could and spent the remainder of the year at some other occupation, thereby eking out a living for the balance of the year.

The brick-maker of to-day is raised to the dignity of a manufacturer—carrying on his business all the year round—employing steam by the hundreds of horse power, digging his clay by steam, carrying it to the machine house by rail, dumping it into large hoppers, and performing all the various manipulations of screening, mixing, tempering, molding, drying and burning without being exposed to weather, and never touching the clay with hands until it issues a completely molded brick. He has his "yard office" and his "city office" and clerks; and if he understands his business, a large balance in bank, a nice square brick of "bonds," and a few corner lots, a row or two of houses, and a nice one for himself and family to live in, and is respected amongst men. He is no longer the despised slave of the Egyptians. *Cyrus Chambers, Jr.*

CYRUS CHAMBERS, JR., inventor of the Chambers brick machine, which is now so extensively used in the manufacture of paving bricks, was born at Kennett Square, Pa., in 1833, of Quaker parentage. He manifested great interest in machinery at a very early age. At seven years he began the winding of bobbins in his father's woolen mill; at ten he constructed an overshot water wheel eighteen inches in diameter, to one end of the shaft of which was attached a model of his father's saw-mill. To the other end of the shaft was a diminutive "fulling mill." This wheel drove also a threshing machine capable of threshing one head of wheat at a time. A monkey laboriously turning a grindstone and various other figures adorned this miniature of his father's mill. The neighbors came from all directions to see this wonderful production of the "small boy." At the age of twelve he was power loom boss in his father's factory. At thirteen he built a small steam-engine, in brass, to embody some improvements in expansion and condensation, and, although now in his sixtieth year, is still working upon that same problem. In his sixteenth year he commenced the study of dentistry with an older brother and during the first seven months constructed the "Golden Miniature Steam-Engine," a high pressure beam engine, the cylinder of which is one-sixteenth of an inch in diameter, and three-sixteenths of an inch in stroke. It is composed of over one hundred and fifty pieces, some so small that they can

scarcely be seen by the unaided eye. The screws are of steel, turned in a lathe. The fly wheel, boiler and bed plate are of silver, and the whole weighs less than one-half an ounce. At the age of twenty he invented the Book and Newspaper Folding Machines which have gone to all parts of the civilized world, and to-day fold nearly all of the books published. Seven years later he invented the leading features of the brick-making machine which to-day produces millions upon millions of brick in various parts of the world. For the Chicago market alone, his machines produce about six hundred millions annually. He has taken out almost one hundred patents in this country and in Europe, and to-day works in his private mechanical laboratory as industriously as ever, developing new inventions. Residing in the suburbs of Philadelphia, in a house surrounded by all the modern appliances for comfort, he enjoys the autumn of his well spent and busy life.

TWO METHODS OF GETTING DIRECT HIGH PRESSURE FROM WATER-WORKS PUMPS.

In most of the lesser cities and in nearly all of the smaller ones and large towns having a public water supply, it is customary to depend in some measure upon direct connection of the fire hydrants with leading lines of hose, for fire-streams, both for use against incipient fires and in case of wide-spread conflagrations.

This use varies from the slight requirements in the first instance, to that where the water-works hydrants are relied upon for the principal protection against fire, the fire engines forming a reserve force in case of accident, needed increase of the number of streams or of extremely long lines of hose.

So thoroughly does a good water-works plant assist the efforts of the firemen, that streams from such plants are desired by them as the most effective attainable; while both parties recognize the exigencies requiring the retention and use of steam fire engines.

It therefore becomes a question how far the principle of direct pressure from the pumps can be advantageously applied to fire protection. This question is not entirely one of population or of pumping capacity, nor can the burning of a few tons of coal be taken as its measure, but it must be settled by the relation of pumping capacity to consumption,

If the pipe system is well designed, able to convey the volume of water required without undue loss from friction and the pipe itself able to stand the strains and shocks arising from direct pressure, then direct pressure is desirable for fire protection, so long as the ordinary consumption, plus the waste due to the increased pressure, still leaves a safe margin, within the capacity of the pumps,

for all fire streams likely to be needed (supposing no scarcity of water to exist).

This condition will, therefore, vary not only with different cities and plants, but also with each city and plant at varying seasons of the year and at different hours of the day.

Many cities and towns are supplied entirely by direct pressure; so that the advantages to be derived therefrom for fire protection are already theirs. It has, however, been found that in all cases where practicable, it is desirable to supplement the pumps by storage reservoirs at sufficient elevation to supply the ordinary consumption and in some instances at elevations sufficient for fire streams.

While in the smaller cities, where suitable elevations for the construction of reservoirs do not exist, in order to avoid the expense of continuous pumping, especially during the night, recourse is had to stand-pipes of iron or steel to act as small reservoirs, but which, owing to the topography of the surrounding country, are seldom sufficiently high to afford efficient fire streams. In order to take advantage of the pumps for direct pressure, gates are usually introduced in the main connecting with the reservoir or stand-pipe, by which they can be shut off and the whole power of the pumps applied through the distribution system. In some cases the reservoirs or stand-pipes are connected with the distribution system only by the force main via the pumping station, where, by proper gates and connections, the force main can be cut out without interfering with the distribution, which thus become subject to direct pressure. Other means have been adopted by different engineers to obtain this much-desired result, with varying degrees of success. A description of two of these methods tried by the author may, therefore, be of interest to others studying the same problem.

The first method was suggested by the striking apparatus connected with the bell of an ordinary fire alarm, viz., motion by means of a weight suspended to a wire rope wound around a drum connected by revolving gears to a ratchet wheel, from which the pawl was released by magnetic action produced by a current of electricity.

The details of this scheme were worked out by the "Coffin Valve Manufacturing Company" of Boston, Mass., and the appa-

ratus was attached to one of their 10-inch gates in the vertical 10-inch supply pipe to the Racine, Wis., stand-pipe in the spring of 1887.

The apparatus was set so that the axle of its drum was in line with the spindle of the gate, to which it was attached by a socket extension.

When the pawl was tripped the fall of the weight was retarded by a fan, attached to the axle of the ratchet wheel, whose angle of striking the atmosphere could be changed so as to regulate at will the length of time required for the weight to drop and in which to close the valve; the time required in this instance, so as not to jam the valve, being found to be about thirty seconds.

The pumps being run slowly at the time of tripping the valve, which is done from the pumping station, the engineer is not taken unawares, and no water hammer occurs, but, watching his gauge, he carefully increases the engine speed till the proper pressure for fire streams is attained, after which only the same watchfulness is required as in ordinary direct pressure.

The stand-pipe in this case is situated on a pedestal 55 feet high, and furnished with separate inlet and outlet pipes; the former 10-inch diameter, fitted with the gate already described: the outlet pipe 16-inch diameter, with gate and check valve; while the inlet pipe rises from the outlet pipe just on the pump side of the check valve.

The pipe, gates, weights and apparatus, are contained within annular chambers 4 feet wide and 15 feet high, within the pedestal.

Electrical connection (open circuit) is made between the stand-pipe and pumping station, one and one-fourth miles apart, with the usual size galvanized iron wire, with the exception of across the Root river, where there is a submerged cable connection. At the pumping station there is a battery of the usual power required to work a fire-alarm circuit of equal length, and the pawl at the stand-pipe is tripped by merely closing the circuit by means of a switch in the engine-room of the pumping station. The mechanical operation of the apparatus was perfected by Mr. S. W. Harris, the engineer first in charge at the pumping station, since

which time no difficulty has been experienced in shutting the gate at will from the engine-room.

The following year a duplicate of this apparatus was connected with the stand-pipe at Janesville, Wisconsin.

The practical difficulties attending this method have been found to be first, the necessity of sending a man to the stand-pipe to open the gate whenever closed; second, the tripping mechanism is so delicate as to be operated sometimes by electric storms.

Neither of these objections are serious when compared with the benefits derived from the ability to close the gate at will, but yet were sufficient to lead the study resulting in the second method, whereby the gate is controlled, or can be both opened and closed at at will, from the pumping station.

The first device for this method was put in two years ago at Marion, Ohio, where the distance between the stand-pipe and pumping station is three and three-fourths miles by the pipe line. In this case the inlet is also the outlet pipe, and is 16-inch diameter.

The device consists of a 16-inch gate operated by hydraulic pressure, inserted in the main pipe line between an ordinary gate at base of stand-pipe and another gate in the street This hydraulic gate, and water cylinder, rests on its side and is an ordinary "Chapman," bell end, hood gate, with composition covered steel piston rod and stuffing box, instead of screw spindle with 10-inch composition lined cast iron cylinder, connected to hood of gate by a suitable yoke; the piston used is of the same type as that for ordinary hydraulic work, and is fitted with hydraulic packing (double leather cups). Each end of the hydraulic cylinder was tapped for one-quarter inch pipe, and when ready for work was connected with corresponding ports of the operating valve, which latter occupies the same relation to the working of the hydraulic cylinder as the steam chest does to the steam-engine; the intake port of this valve was connected with the 16-inch main by two lines of three-quarter inch pipe one on each side of the 16-inch gate, each line being fitted with gate and check valve, and the lines being united before reaching the operating valve; the object of this double connection being to utilize the pressure in the main pipe line on that side of the gate where it should be greater. It will been seen that by throwing

the pressure through the operating valve, into the end of the cylinder next to the gate, the gate will open, while if the pressure is applied to the other end the gate will close, the exhaust being back through the exhaust ports in the operating valve.

This operating valve was designed by A. H. Holland, civil engineer, and consists of a cast iron shell, composition lined, of about two inches interior diameter, and having transversely of the cylinder, five ports one-quarter inch wide, one for the inlet, two for the operating, one connecting with each end of the hydraulic cylinder and two exhaust ports. On a one-half inch valve stem are three brass pistons, three-eighths inch thick, so arranged that a movement of the valve stem of five-eighths inch will divert the pressure to the operating port at one end of the cylinder and cut off the exhaust at that end, while the same motion will shut off the pressure, and put the operating port and exhaust in connection at the other end.

The pipe used was three-quarter inch reduced at the operating valve and at the hydraulic cylinder to one-quarter inch. Under these conditions and with a stand-pipe pressure of about 45 pounds the 16-inch gate opens or closes in 45 to 50 seconds.

In order to light the pumping station, and also to furnish means of controlling the operating valve, there was erected at the pumping station a small, high speed, vertical steam-engine, of five-horse power and an arc dynamo capable of the same effort. At the operating valve was set a lifting magnet, capable of lifting 200 pounds. This magnet consisted of two pair of spools, set in a cast iron frame, above which was attached a rocking arm, carrying at each end a heavy bar of soft iron; the motion of this rocker arm necessary to bring either bar of iron in contact with its own particular pair of spools was about one-quarter inch; on top of this arm was attached another, of sufficient length to give the proper length of stroke to the operating valve, with which it was connected by a rod and bell crank. An insulated copper wire (No. 8, B.W. G.), was run from each pair of spools at the lifting magnet (two wires required) to the switch board at the pumping station, where a three way switch set on the center cuts the electrical current out from both wires; set on either side, diverts the current to and through the pair of magnet spools wired to and con-

nected with that point, instantly attracting the bar of soft iron attached to the rocker arm and thus moving the operating valve as desired, and through that the main gate.

Shortly after the erection of this apparatus, a duplicate was erected at Decatur, Alabama, and during the two years that have since ensued, the magnets at either place have never failed to respond to the application of the electric current at the switchboard at the pumping station; in fact the engineer at Marion states that by actual trial he has found it impossible to make and break the contact so quickly as to fail to work the magnet and valve. During these two years the valves have been operated at least twice each week to make sure that connections were perfect, valves in working order, etc., but the magnets have never worked except when the current was turned on to them at the switchboard.

The only difficulty developed in operating has been that the hydraulic cylinder was not large enough to overcome the drag of the gate upon its seat in starting to open it, if the pumps were stopped and full stand-pipe pressure thrown on one side of the gate; as, however, this was easily remedied by slowing down the pumps till the pressure became the same as that of the stand-pipe, and operating the gate while it was thus balanced, no practical difficulty has been experienced, while to guard against isolation of the stand-pipe in case of a burst on the long force main, the hydraulic gate is "by-passed."

In building new it might be desirable to construct the hydraulic cylinder of the same diameter as the gate itself.

It was complained at one time that the gate opened quicker than it closed, but an examination developed the fact that this was apparent rather than real, the closing not showing on the gauge till the gate was nearly shut, while its effect was noticeable in opening to the same extent, but in the first case at the end and in the latter case at the commencement of the piston travel.

The success of this second method of securing direct pressure has been such that it can be confidently recommended wherever it can be applied. If in a city where there is always maintained a 24-hour electric service, the expense of steam-engine and dynamo could be avoided.

If all machinery is standing still at time of the alarm, the engine

and dynamo can be running full speed before the main pumps will be ready to "speed up," and whether running or not can all be ready to respond to the call of the Chief of the Fire Department by the time he can get upon the ground and determine that he wants direct pressure.

There are no patents on the combinations by which this result has been secured. *Geo. A. Ellis.*

CURRENT INFORMATION.

SAND FOUNDATIONS FOR PAVEMENTS.

In the December number of PAVING AND MUNICIPAL ENGINEERING a letter was published on the subject of sand and gravel foundations for brick pavements, the authorship of which was attributed by mistake, as we have since learned, to Charles P. Chase, of Clinton, Iowa. It is due that the explanation should be made even at this late day that the author was Mr. B. B. Hart, city engineer of Clinton, Iowa, instead of Mr. Chase. Some additional information is given by Mr. Hart in correspondence with him on this subject as follows:

"In my railroad experience, having been successful in building permanent mechanical structures, culverts, upon a quicksand foundation, without piling, the sand being thoroughly confined, where heavy locomotives and trains were often passing rapidly over it, I have implicit confidence in a properly constructed sand foundation. I have often regretted that I did not substitute sand in my first specifications for brick pavement here, as the sole foundation."

IGNORANT OPPOSITION TO STREET PAVING.

In enlightened communities it is well understood that there can be no more profitable expenditure of money than for needed public improvements, but there are many non-progressive towns in which there is amazing ignorance of the benefits to be derived from such work. A remarkable instance of this is brought to attention by a newspaper report of a recent meeting of citizens in Xenia, O., to protest against the proposed paving of a street there with brick. Various absurd objections to the improvement were offered, concluding, finally, with a plea by one citizen, a physician, for abolishment of the use of the street scraper, because "it hauled off material that should be used for filling." This, indeed, is a hopeless case.

PUBLIC WORK IN MEMPHIS.

The annual report of Niles Meriwether, city engineer of Memphis, for 1892, is thorough, interesting and valuable. It comprises over a hundred pages, fully illustrated, and contains much useful information regarding the public work done in Memphis. The statistical part of the report shows that different kinds of paving have been laid in Memphis at an average cost as follows: Cedar block, 32,799 square yards, $1.92 per square yard; granite blocks on concrete, 46,394 square yards, $4.35 per square yard; brick on concrete, 34,004 square yards, $2.90; granite blocks on gravel, 5,240 square yards, $1.91; limestone blocks on gravel, 246,726 square yards, $2.15; limestone blocks on concrete, 3,548 square yards, $3.65; Telford and macadam, 229,752 square yards, $1.15. The report embraces also a complete review of the sewerage of Memphis, to which there was added during 1892, 1.37 miles of the Chelsea

system. During the year fifty-one stoppages were removed from the fifty miles of sewerage at a cost of $106.20, an average of $2.08 per stoppage.

THE PROPOSED NATIONAL ROAD DEPARTMENT.

Col. Albert A. Pope, the indefatigable advocate of governmental direction of road improvement, has published in a pamphlet of a hundred pages, a memorial to Congress on the subject of creating a national road department, and also further urging an exhibit of roads, their construction and maintenance, at the World's Columbian Exposition. The memorial sets forth the indorsement of Col. Pope's plans by hundreds of men prominent in public life, newspapers, legislatures and official bodies. In speaking of the petition circulated by his direction, he says: "Many persons objected to signing this petition for a road department because they believed that roads were of such comparative importance that a department was unnecessary, and a bureau in the agricultural department would be sufficient to accomplish all that was necessary. Substantially this view was taken by a great many editors of newspapers, who, through their columns, urged their readers that it was not advisable to sign the petition unless the word 'bureau' was substituted for the word 'department.' The governor and the justices of the Supreme Court of Rhode Island signed a petition after they had stricken out the word 'department' and substituted 'bureau.'

"In this connection it should be stated that it has been maintained in the columns of some newspapers that the creation of a road department necessarily meant the appointment of another cabinet officer. I do not believe it was the wish or intention of the signers of the petition, as it surely was not mine, to enlarge the number of cabinet officers.

"I believe that all those who objected to there being a department erred because they did not fully realize the paramount importance of the subject. A glance at the statistics of the nation would remove this erroneous impression. For example, Poor's Manual gives the capital of the railways of the country for the year 1891 as $10,122,000,000. I venture to assert that the value of the land upon which city streets and country roads are built, and the cost of the construction and maintenance of these streets and roads exceeds in amount the cost of the railways. In other words, I do not hesitate to say that the streets and roads of the United States represent a value of ten billion dollars, a sum far greater than the total valuation of all the real and personal property in the United States in 1850.

"It is absurd to assert that this amount of property is of so little consequence to the nation as not to justify a department of roads. I find in the report of the Inter-state Commerce Committee for the year 1890 that the number of railway employes in this country was 749,301. The population of the United States in 1790 was 3,929,214. Assuming five persons to a family, it is probable that the railway employes and members of their families are in number greater than the entire population of the United States at the close of the Revolution, and I believe it may be assumed that there are employed in the constrction and maintenance of city streets and country roads as

many persons as are employed on the railroads.

"Objection was made to signing the petition by a large number of citizens and by some newspapers of the country, because, as they understood the phraseology of the petition, it had for its object the construction and maintenance of national roads. Such a misconception seems inexplicable. Surely language could not more clearly express that the object of the road department was simply to promote knowledge in the art of construction and maintenance of roads.

"The proposed road department need not necessarily be limited to the promotion of knowledge in the art of the construction and maintenance of city streets and country roads—it might also embrace railways, and such department might be expanded as to take up the question of transportatian and be virtually a transportation department."

CONVICT LABOR AND BRICK-PAVED HIGHWAYS.

Mr. A. O. Jones, World's Fair Commissioner for Ohio and president of the A. O. Jones Brick and Terra Cotta Company, advocates the use of convict labor in making paving brick for use in paving the public highways. In urging the adoption of his plan in Ohio he says: "There is no reason why we should not erect work-houses in locations where suitable shale, clay and coal can be procured at reasonable prices, and near good railroad shipping points, and have the convicts employed at brick-making inside of inclosures, and even turn the present penitentiary into a huge brick plant, the clay and coal to be unloaded and the brick loaded back on cars, and all the railroad switching to be done at night when the prisoners are safe in their cells, stamping every brick with O. C. L. —Ohio convict labor—and impose a heavy fine and imprisonment if they are used for any other purpose than road-making and state purposes." Mr. Jones's ideas received very favorable consideration from members of the Ohio legislature.

DISPOSAL OF SEWAGE.

Prof. F. O. Marvin, of the Kansas State University, is giving a series of lectures in Kansas City on municipal and domestic sanitation. In the last of these he talked about the disposal of sewage and in discussing the subject said:

"A complete system of town drainage should include: First, impervious sewers; secondly, storm water sewers, and thirdly, sub-soil drains. Few towns have all three of these sets. Generally large sewers are designed to carry the storm water, and are placed deep enough to catch the sanitary sewage. These also act as sub-soil drains because of the pervious character of the materials of which they are made.

"In form they should be adapted to give the greatest economy of material and cost, and the greatest strength and freest flow. For smaller pipes cast iron or clay have been used, and have the advantage of being impervious. For the larger size, brick, concrete or stone is used. But through these materials the ground water will come in, or, under pressure, the sewage may be forced out and so pollute the soil.

"The size of a sewer depends on the density of the population, the amount of waste water, grades, the materials, the extent of the system, the variations in sewage flow and the amount of storm water that will reach the sewers. The carrying of

waste water is usually assumed in America at from fifty to seventy-five gallons per head per day. As to the density of population, 30,000 to 200,000 people to the square mile has been assumed. Sewers can not be designed to carry the rainfall from excessive storms. The cost would be too great. So English and American practice assumes a rainfall of from one to two inches per hour, one-half of which will reach the sewers within the hour, as the basis of calculation.

CLOSED CONDUITS FOR ELECTRIC STREET RAILWAYS.

In a paper read before the Buffalo Electrical Society, on March 6th, Frank C. Perkins described the several patents for closed conduits to take the place of the trolley in the operation of electric street railways, including his own, and in discussing questions as to whether closed conduits will supercede the trolley in large cities, said:

"It would be folly for any one to assert that the trolley system for operating electric railways will be thrown out of use in small cities, villages and rural districts; and until some efficient, practical and reliable closed-circuit system is brought before the public, the trolley will still continue to be used in the large cities as well.

"A conduit system, however simple, could not compete with the trolley in the country, where long lines are necessary, and where wooden poles and a comparatively cheap line construction give good satisfaction to the railway company, and is not seriously objected to by the public.

"In large cities, however, where the trolley system is so greatly objected to, on account of the so-called "unsightly overhead wires," the conduit system, when perfected, will find many advocates, and will be readily adopted by street-railway companies interested. After looking at a street crossing in Boston, with its network of wires as used in the trolley system, and then noticing the entire absence of overhead conductors in the city of Buda Pesth, Hungary, one is impressed with the advantages of the conduit system as well as the great difficulties under which our firemen have to work. Regarding the cost of construction, a conduit system would compare very favorably with the trolley in cities where the authorities insist on the feeder-wires being placed in underground conduits and where an expensive line construction, with iron poles, guard-wires, etc., is required.

"The systems now in use for operating electric railways are, 1st, the trolley, and second, the open-slot conduit. Every one is so familiar with the trolley system that to go into details regarding its operation would be a waste of time; but we are not so familiar with the open-slot conduit as it is not in general use at present.

"The Siemens and Halske system has been in use for some time in Buda Pesth, Hungary. The Love system is now in operation in Chicago, and the Bentley-Knight system was operated a short time in Boston, but has not been in use for several years. The greatest difficulty the companies using the open-slot conduits have to contend with is maintaining a good insulation for the main conductors, the loss of current through leakage in wet weather being sometimes very great. Many methods have been proposed whereby closed conduits might be used, thus avoiding the misuse of

the conduit for a sewer, as is often the case with open conduits''

COST OF PUBLIC WORK IN WASHINGTON.

Capt. G. J. Freiberger, corps of engineers, U. S. A., assistant to the engineer commissioner of District of Columbia, in his annual report for 1892, shows that with the work done during the year, Washington now has street pavements as follows: Street pavement, 2,064,999 square yards; asphalt block, 270,459; stone block, 544,157; rough stone, 319,031; macadam, 287,917. This paving covers 66⅔ per cent. of the streets of Washington. The work done during the last year was by contract at the following prices:

Sheet asphalt on 6-inch concrete base, exclusive of grading, per square yd..$	2 25
Sheet asphalt on 4-in. bituminous base, exclusive of grading, per square yard	2 00
Asphalt block on gravel base, exclusive of grading, per square yard	2 00
Granite block on gravel base, exclusive of grading and cost of block, per square yard	95
Granite blocks delivered at yards, $43 to $46 per M, per square yard	1 80 to 1 93
Ordinary macadam, 12½-inch thick, exclusive of grading	92½
Telford macadam, 8-inch base, 5½-in. macadam, exclusive of grading	99½
Brick sidewalks, exclusive of grading and price of brick, per square yard	20 to 31
Relaying same, exclusive of grading and price of brick, per square yard	20 to 36
Bricks, paving, delivered on street, $10.39 per M, per square yard	38
Tile walks, exclusive of grading and price of tile, per square yard	42
Vitrified tile, delivered at yard, $36 per M, per square yard	58
6 by 20-inch granite curb set, exclusive of cost of curb, per linear foot	16 to 25
6 by 20-inch granite curb, delivered at property yard, per linear foot	99
8 by 8-inch granite curb on 6-inch concrete base, exclusive of cost of curb, per linear foot	40 to 50
8 by 8-inch granite curb, delivered at property yard, per linear foot	87
Resetting 6 by 20-inch curb, per linear foot	09 to 16
Cobble gutters, exclusive of cost of material, per square yard	16 to 20
Vitrified brick gutters on 6 inch concrete base, exclusive of cost of brick, per square yard	1 27
Vitrified brick, delivered at property yards, $16.88 to $19 per M, per square yard	1 01 to 1 14
Cobble taken up and removed to property yards, per square yard	08 to 15
Old curb taken up and removed to property yards, per linear foot	05 to 08
Grading earth, 500 feet haul, per cubic yard	18 to 40
Grading macadam, 500 feet haul per cubic yard	35 to 68
Hauling earth and macadam each 100 feet over 500, per cubic yard	00¼ to 01½

MASSACHUSETTS HIGHWAY ASSOCIATION.

The Massachusetts Highway Association has been organized, with W. E. McClintock president, and C. R. Cutter secretary. The purpose of the association is to extend acquaintance among members, present papers and discuss progress and to visit different fields of work. The charter members include some of the most progressive road engineers of the state. President McClintock is at the head of the road engineering department of the Lawrence Scientific School, of Harvard college, and is a member of the Massachusetts State Highway Commission.

COST OF HIGHWAYS IN ENGLAND.

The annual cost of maintenance of main highways in the county of Hampshire, England, averaged for the nine years ending March 25, 1889, the sum of $125.97 per mile. The total mileage in the county was 382 miles in 1880, and 532 miles in 1889. The proportion in 1889 was 490 miles in the rural districts and forty-one miles in urban districts, the average cost of maintenance of the former in 1889 was $97.80 per mile, and of the latter $531.77. Besides the main highways there are in the county about 3,100 miles of rural roads, maintained at an expenditure of about $100,000 per annum, and about 210 miles of urban district roads, on which some $65,600 is expended, or an average per mile of $32.30 and $312.40, respectively.

SOME RECENT INVENTIONS.

A Curb Box Cover. 492,227. Daniel O'Neil, Rochester, N. Y. This invention comprises an annular, internally shouldered bed piece

adapted to be secured to the top of the pipe, the bed piece being provided with two internal, spiral segmental ribs, diametrically opposite each other, each having its lower end abruptly inclined downward, and having its upper surface substantially horizontal, and its lower surface inclined downward, and a cylindrical plug adapted to fit within the bed piece, and having shoulders to engage with the shoulders of the bed piece, and also with two projecting bosses diametrically opposite each other to engage with the spiral ribs of the bed piece, the upper face of each of the bosses being flat to engage with its respective rib, to secure to the plug in the bed piece, and the lower face being beveled or inclined to engage with the inclined end of the rib and raise the plug out of the bed piece.

A Drain Pipe. 492,191. Alonzo W. Cram, Haverhill, Mass. This invention comprises a pipe section having an opening, a cover therefor, a yoke secured over the cover which is formed with a cross slot or recess and an intersecting vertical recess, a screw-threaded nut adapted to be inserted in the cross slot, and a screw adapted to be adjusted through the nut and vertical recess in the yoke for the purpose of clamping the cover in position.

Pipe Coupling or Fitting. 492,159. George W. Harrington, Wakefield, Mass. This invention comprises a hard metal shell internally screw-threaded and having two internal enlargements, a lead lining or bushing formed within the shell and screw-threaded at its ends to form lead continuations of the screw threads at the ends of the coupling, the intermediate portion of the shell and lining projecting inwardly and forming shoulders against which the ends of the pipe sections abut.

A Bridge Gate. 492,387. Theodore F. Conklin, assignor to Nathan S. Lepperr, Chicago, Ill. This invention comprises pivoted guard bars of pivoted and horizontally movable levers, the inner ends of the levers being connected together and extending outwardly in position to be operated by the swinging bridge, and forming a double incline, and connections uniting the outer ends of the levers to the ends of the pivoted guard bars.

A Levee and Dam Structure. 492,704. George P. Anderton, Concession, La. This invention comprises a boxing composed of a series of sections secured together and a plurality of crown or top pieces adjustable to and from each other.

A Sewer Guard. 492,450. Samuel T. Williams, Baltimore, Md. This invention comprises a frame mounted in the sewer opening, rotary devices located in the opening and mounted in the frame and adapted to be revolved automatically by the water flowing into the sewer.

A Street Sweeper. 492,487. Patrick Reardon, Paterson, N. J. This invention comprises a broom having a broom head provided with a hole to receive the end of a pole, the pole and a clip provided with side braces, a bracket secured to an axle, the bracket being provided with projecting lips formed to embrace the side of the pole of a handle, rubber cushion washers inserted between brace arms and the pole or handle, and wheels secured to the axle, the pole being provided with two series of holes to permit the pole to be secured to the bracket arm at different parts as desired.

A Street Sweeper. 492,489. Fran-

cis C. Williams, Philadelphia, Pa. This invention comprises a traveling support, a containing receptacle, a revolving brush, a carrier, arms by which the carrier is pivotally connected to the machine, and gearing adapted to occasion the elevation of the carrier.

V. H. Lockwood, Patent Att'y.
Indianapolis, March 23, 1893.

RECENT LEGAL DECISIONS.

Construction of Railroad in Street —Duty of Company to Restore Street to Former Condition.—License from a city council to a railroad company to build its road across, along or upon a public street gives it no power to destroy the street, and the company is bound to restore the street to its former state, or to such state as not unnecessarily to have impaired its usefulness for the public, and also to build proper crossings over the railroad and keep them in good repair. If it fails to do so the company may be compelled to do so by mandamus; and, as the company is guilty of maintaining a nuisance, equity may entertain a bill to abate such nuisance, and may compel the company to perform its duty. City of Moundsville *v.* Ohio R. Co., Sup. Ct. Appeals. W. Va., 8 Notes of Cases 15.

Agreement Contrary to Public Policy—Railroad Company Closing Streets—Suit by City.—An agreement by a city not to oppose a railroad company's closing certain of its streets crossed by the latter at a grade in consideration of the making of compensation solely to private individuals is void as against public policy.

The invalidity on the grounds of public policy of a contract by a city with a railroad company will be considered by the court in an action to enforce it although such validity is not pleaded.

A municipal corporation can not become a trustee to collect in its own name, especially at its own expense, separate sums of money due to some of its citizens for damages from the closing of streets by a railroad.

A contract between a city and a railroad company by which the former consents to the closing of certain streets upon the consideration that the latter shall pay certain damages to thirty-five different property-holders, if enforcible at all, can be enforced only by such property-holders.

A demurrer to a complaint by a city upon a contract between it and a railroad company by which it consents to the closing of certain streets on condition that the company pays to thirty-five different property-holders injured thereby the damages sustained, must be sustained even if such property-holders have a right of action thereunder, since such rights would be several and not joint, and the court is not required to select and substitute one of the thirty-five claimants in place of the city. City of New Haven *v.* New Haven & Derby R. Co., Conn. Sup. Ct. Errors, 18 L. R. A. 255.

Street Railway Company Using Bridge Belonging to State.—A street railroad which lays its track across a bridge constructed and maintained by the State, and constitutting a part of the highway on which the railroad line runs, does not adopt the bridge as one of its appliances so as to become liable for an injury to a passenger, caused by defects therein, to the same extent as if the bridge had been built by the company. Birmingham *v.* Rochester City & B. R. Co.,

N. Y. Ct. of Appeals, 32 N. E. Rep. 995.

STREET-CROSSING STONES.

Engineering News advises that crossing stones should never be smooth or made of a stone that will wear smooth. Sandstone, though wearing somewhat rapidly, is one of the best materials for this purpose. But if granite is employed, the top surface should be hammer-dressed. No crossing stone should be more than ten inches wide; and if two rows are required, it is well to put one or two rows of paving blocks between them. New York practice, however, does not quite agree with these requirements. Granite, in comparatively narrow blocks, is generally used, and it soon wears smooth. They are very frequently renewed in much-traveled streets. As any crossing-stone is more or less liable to cause horses to slip, they are in that sense a nuisance, and the fewer there are of them the better.

PERSONALS.

Mr. Frank P. Johnson has been elected city engineer of Waltham, Mass.

Mr. Alexander Potter, of Olean, N. Y., has opened an office at 137 Broadway, New York.

Mr. Walter Lodia, of Paris, is in this country, and will represent several English publications at the World's Fair.

D. J. C. Arnold, of New London, O., has issued an attractive catalogue of his brick and tile makers' supplies, freely illustrated.

Mr. Wm. Smith has been elected engineer for Wilmerding, Pa.

Prof. William H. Burr has been appointed professor of civil engineering in the School of Mines at Columbia College, New York City.

Mr. James B. Gass, city engineer of Fort Smith, Ark., has been engaged to prepare plans for a complete sewer system for Jefferson City, Mo.

Mr. Campbell G. Ellwood, formerly superintendent of the Philadelphia Gas Company, has been appointed assistant superintendent of the Department of Public Works of Pittsburgh, Pa.

The following have been appointed as highway commissioners for the state of Vermont: Col. Geo. W. Hooker, of Brattleboro; Prof. J. W. Votey, of Burlington, and Hon. O. L. Hinds, of East Higate.

Mr. F. A. Dunham, engineer in charge of street improvements at Olean, N. Y., has been reappointed city engineer of Sewickley, Pa., where extensive paving and sewerage improvements are being made.

Mr. F. F. Foote, formerly city engineer of Kenosha, Wis., has resigned that position to enter into the contracting business with Mr. P. W. Galloway, of Racine, Wis. Racine will be the headquarters of the new firm.

The following officers have been elected by the Canadian Society of Civil Engineers: President, E. P. Hannaford; vice-presidents, Thomas Monroe, P. A. Peterson and W. J. Jennings; secretary, C. H. McLeod; treasurer, Herbert Wallis.

LETTERS FOR THE PUBLIC.

CONCRETE OR ARTIFICIAL STONE FOR STREET PAVING.

To the Editor of Paving and Municipal Engineering:

SIR—I see in your valuable magazine, discussions as to various kinds of street paving, but I have seen nothing about the use of concrete and artificial stone for paving streets. Have streets been paved with cement stone? Is there any reason why this material will not make a first-class street pavement? I have heard that streets have been paved as above in some towns in Canada, also in northern New York. I would be glad if you would answer through your magazine, as a matter of information to the writer as well as your other readers.

Paver.

Mobile, Ala., March 7, 1893.

[The questions asked in the foregoing communication were submitted by the editor of PAVING AND MUNICIPAL ENGINEERING to Mr. Warner H. Jenkins, concrete engineer and G. W. Bartholomew, jr., secretary and manager of the Buckeye Portland Cement Company, whose answers are given below.]

To the Editor of Paving and Municipal Engineering:

SIR—Referring to your communication of the 13th instant, I have seen the experiment of paving street ways with concrete, and have had occasion to thoroughly examine them after being in position for several years. It is hardly necessary for me to state that the result was a failure. After the crust or trowel finish had worn through, the rougher particles would readily peck out and crumble. At present I can not think of any particular work of the kind, but would emphatically disabuse the idea, where it was to be used for wide street ways, with large traffic.

Warner H. Jenkins.

Philadelphia, March 15, 1893.

To the Editor of Paving and Municipal Engineering:

SIR—Yours of 13th inst., asking if Portland cement has been used for streets in this or any other country, is received. I am glad to see your interest in this subject. It is certain to increase with wider knowledge of the merits of Portland cement pavements. No one familiar with good Portland cement driveways, gutters, etc., can have any doubt about the durability of it under the most trying conditions.

But answering your question: Modern street pavers, while depending upon cement for the foundation of all street surfaces, have apparently had the idea that there was some reason why cement could not be used for the surface. Yet the many roads, aqueducts, bridges, culverts, etc., of ancient times, now in existence, were made with cement, Roman artificial cement. These roads, bridges, etc., after resisting the elements and wear of man for over a thousand years, are in good condition to-day. Modern street pavers have lost sight of that, also of the fact that the oldest sea walls of Europe and Italy are made of cement, and have resisted the strongly disintegrating properties of salt water and sea air and the breaking of the waves on their surfaces for nearly two thousand years, and are still doing their duty. All natural stones under similar conditions have been short-lived.

The ordinary granite and sandstones were put together by the chance quality of cement that nature had at hand to supply. And while the individual grains may be the hardest common natural material in the world the cement hold-

ing them together usually disintegrates in a comparatively few years when exposed to moist air and frost.

But Portland cement is a striking illustration of the improvement of art over nature. The best chemical knowledge has been used to so proportion and prepare it that it will withstand the elements and gradually improve rather than disintegrate. It is well known that concrete made of the Portland cement of to-day has more strength when one week old than the celebrated cement that the Romans built their roads with ever had.

Yet, as I say, modern street pavers have in some way overlooked it, or have thought it too expensive to use for that purpose. Often where some government building or elegant residence needed a driveway, or a conspicuous entrance, like that to a livery stable, has been built, they have used Portland cement concrete, and a permanent work was the result. This is the case in Europe and America generally. When neat and durable gutters, curbs and street crossings have been desired Portland cement concrete has been used. Gutters receive harder wear than any other portions of the streets when horses are kept constantly hitched on them, as flies in summer and cold in winter make them paw and stamp their steel-calked shoes against the pavement with great force; and often as one horse is taken away another takes his place.

It is in the gutter that the heavily laden drays and wagons back around and cramp their wheels sideways over the pavement. Portland cement has been standing this wear for a great many years without repair.

Its actual use as the surface of the street is mentioned by Feichtinger in Germany before 1885. It was used on at least a part of the main street of Sioux Falls, South Dakota, two or three years later. A block of the latter said to be taken from the most worn portion of the street was on exhibition at the Indianapolis Paving Exposition and was all that could be desired for a pavement. I have been informed recently that it is unchanged in every respect by age. At Bellefontaine, Ohio, the most severely used portion of the main street was paved with Buckeye Portland cement several years ago, and is entirely uninjured by the constant and severe usage it has received. The surface remains almost as unbroken as the surface of the paper on which I write. If it would be of interest I could give you the specifications used at Bellefontaine. It was laid in small (about one yard square) blocks which are separated by tarred paper and are so arranged that a row can be removed to get at pipes, etc., and replaced without any cutting or injuring the pavement. That is very important and can not be done with any other paving material.

Paving cement can not be surpassed as a non-absorbent body. Its surface is just as the roller used leaves it, rough enough for hoofs to hold and smooth enough to please the driver.

Heat and water soften and soon destroy asphalt streets unless they are constantly repaired, but have no effect whatever on good Portland cement concrete. In fact, all other pavements have their serious faults, but concrete, well made, has, practically speaking, none. It contains the special qualities desired for city street paving, viz.: Health,

agreeableness, durability and economy. *G. W. Bartholomew, Jr.*

Harper, Ohio, March 14, 1893.

LESSONS FROM PAVING AT COLUMBUS, OHIO.

To the Editor of Paving and Municipal Engineering:

SIR—I notice in your valuable magazine many references to the paved streets of Columbus, Ohio, some of which are erroneous. Having constructed about two-thirds of the street pavements here, I am in a position to state the facts. The city engineer's report for 1891–92 shows that there has been constructed about 1,400,000 square yards of street pavement since the passage of the "Taylor Street Improvement Law" in 1886. This would be equivalent to eighty miles of thirty-foot roadway, but as most of our streets are wider than thirty feet between curb lines, the actual miles are given as 70.53. This report does not include several miles completed late in 1892, nor over three miles paved outside of the city limits. Including all of these and some paving done before 1886, the total street paving here aggregates ninety miles of thirty-foot roadway. Taking the engineer's report referred to as a basis, the 1,400,000 square yards of paving is distributed among different materials about as follows:

Hallwood paving block	25 per ct.
Asphalt	17 "
Red brick of various kinds	17 "
Hayden paving block	15 "
Fire-clay paving brick	13 "
Stone block pavement	9 "
Boulder pavement	4 "

I venture the assertion that no city in the country can show so large a proportion of its paved streets in good condition as Columbus. This, if true, indicates that a good plan has been followed, and that not many mistakes have been made in material or workmanship.

A full history of our street paving might be interesting, but would be too long for this communication. I will only refer to the lessons learned as to paving brick, which is coming so largely into use. We have a few miles of pavement made of "red brick" and "fire brick" that have not proved satisfactory. These were constructed on the same specifications as adopted for all streets, but the mistake was made of selecting brick of coarse, porous grain and insufficiently burned. Fortunately this defect was discovered early and the proper cure applied. The common, plain paving brick when vitrified have worn very well, but our best results have come from the use of repressed bricks or blocks which have been burned to a vitrified state.

In selecting the best material the practical test found most effectual is "absorption." Any clay material that will absorb much water will be found deficient in frost resisting and wearing qualities. So great a difference has been found between the ordinary paving brick found in the market and the improved, repressed and vitrified material that has been developed, that the latter is called a paving block as a distinguishing feature of the material.

The size of the blocks used is also larger than the brick commonly used, and we have found that these paving blocks can be made very close to the best paving stone in texture, toughness and durability. When manufacturers reach the point that *all* of their product placed in the market is *as perfect as the best*, then paving blocks made of the proper kinds of clay will be used

more generally than any other material for street paving.

The Columbus specifications require a foundation of eight inches of broken stone, rolled with a ten-ton steam roller, two inches of sand, blocks or bricks set on edge and rammed, and joints filled with hot coal tar pitch. The folly of laying a poor paving brick according to such specifications is apparent. If a poor brick must be used, its foundation and finish may appropriately be of the cheapest character.

I have noticed that many of the smaller cities and towns call for a deep curb in their specifications, often as deep as twenty-four inches. This is a needless expense on paved streets. In Columbus the curb is five by eighteen inches, set on six inches of gravel and backed with six inches of gravel. This depth is sufficient, if the curb is properly set, as the perfect lines of the curb on our streets will show.

Ten years ago Columbus was sneeringly called a one-horse town. Its unimproved and muddy streets, and old fashioned buildings gave cause for the name. To-day it compares favorably with any capital city. The direct cause of the change is its general and thorough system of street improvements, which has been legitimate, followed by improved architecture, improved business and improved comfort.

N. B. Abbott.

Columbus, O., March 7, 1893.

DAMAGE TO BRICK STREETS BY ELECTRIC CARS.

To the Editor of Paving and Municipal Engineering:

SIR—In looking over one of our best brick streets, I have come to the conclusion that street car tracks, if used for heavy electric cars, are as detrimental to brick streets as they are to asphalt streets. This street has been down about three years, and is in fine condition, with the exception of the space between the rails and a few feet along the outside of them. This portion of it is bad, having settled about three inches, and in places the rails have worked the brick up, and wagons ground them to pieces, making holes in the pavement, and giving water a chance to get into the foundation. The ties for these tracks were laid on the sub-grade, only enough gravel being used to level up. It appears that in order to make a good brick street where railway tracks are in it, the ties will need as good a foundation as the pavement, in order to obviate the above defect. Cities that are putting down brick pavement, and have electric railways, should give this subject some consideration, or they may regret it in the future.

F. W. Cerny.

Columbus, O., March 10, 1893.

MR. SCHUBERT AGAIN REPLIES TO MR. DELANO.

To the Editor of Paving and Municipal Engineering:

SIR—I ask again your indulgence, and request you to allot a space in the next issue of your valuable magazine for the following reply to Mr. Delano's letter.

Mr. Delano, in his last letter, does not prove the correctness of the proverbial politeness of the French people, at least he, himself, can not be counted in, when the question of politeness is considered.

He accuses me of repeating old calumnies and blunders, when all and every one of the malicious accusations and misrepresentations ever uttered in your columns, regarding the asphalt and asphalt

pavement, originated directly from him.

Mr. Delano denies again that your Paris correspondent did receive information from him, while your correspondent in the February number of 1892 says himself, that he gives below the translation from Mr. L. Malo's book on asphalt, which contains the malicious attack on American asphalt. Mr. Malo and Delano are partners, and the same spiteful utterances as taken from Mr. Malo's publication came to our ears in 1886 and 1887, emanating directly from Mr. Delano. Is this not enough to prove that he instigated the underhanded attacks on American asphalt? Has he not, in his writings, confirmed all my statements, that he was at the bottom of all this unpleasant controversy?

Mr. Delano is to make a present to your Paris correspondent of his little book on asphalt, but this present can not atone for the injury he, Mr. Delano, has done to your correspondent. I hope that your correspondent will take time to study up asphalt and asphalt pavements more fully before he accepts Mr. Delano, unconditionally, as authority on asphalt. If he does so, he will find that "What Mr. Delano does not know about asphalt" will fill a big book, if he still holds to his claim that limestone impregnated with asphalt is asphalt, and that all other materials are simply pitch.

Your correspondent will find in Mr. Delano's last letter a partial acknowledgment that street car tracks are detrimental to asphalt pavements, because Mr. Delano says "One thing is, that four lines of rails in a roadway increases the maintenance thereof, there are ten joints instead of two." Of course the extra maintenance demanded by the Delano Company was large enough so that the authorities of Paris found it cheaper to put down stone and wood pavements, instead of asphalt, after the failure of the American company. I repeat again, that Mr. Delano's asphalt, abutting the American asphalt, would have been also considered a failure, had it been laid by the American company, for reasons given in my last letter: yet no rails were in that portion of Rue de Rivoli.

Mr. Delano gives, in his letter of December 19, 1892, the quantities of compressed asphalt laid, as follows:

Berlin, 1,000,000 square yards.
London, 600,000 square yards.
Paris, about 500,000 square yards,

and claims in his letter of February 15, 1893, that these figures are official. I will give below the official figures of 1892:

Berlin, 1,036,176 square yards.
London, 360,000 square yards.
Paris, 385,351 square yards.

There is considerable discrepancy between the official figures and Mr. Delano's, but all of Mr. Delano's utterances have to be taken with the same degree of allowance. He sees himself and his work in such a magnified condition that it is impossible for him to convey the correct meaning to others. Look at his last utterance: "My company, as originator of the compressed asphalt industry, supplies the workmen and tools, and continues to supply the rock."

Only one who knows the true condition of affairs can appreciate the enormity of these misrepresentations. In Berlin, only one firm is taking the rock asphalt from the Seyssel mines, and this firm can

not get more than one-fifth of the total yearly quantity to be laid in that city, and has been for a large number of years independent of the Delano Company, as regards the tools and the workmen. I have not a doubt that the same condition exists in London.

Julius Schubert.

New York, March 21, 1893.

SELECTIONS FROM THE PRESS.

CONCRETE HIGHWAY BRIDGE IN GERMANY.

An interesting type of framed concrete arch built near Erbach, Wurtemberg, Germany, is described in the *Deutsche-Bauzeitung*. The span of the arch is 105 feet, with a rise of 13.1 feet. In order to prevent cracks in the structure, and to counteract any motion in the abutments, which were constructed in somewhat soft ground, thin asphalt plates were inserted into arch, two at each end, near the springing lines, and one in the apex. These asphalt plates had a thickness of ⅞ inch at the top, and 19-32 inch at the bottom and were made up of several layers. After the arch had settled 1.9 inches, these plates were compressed to a uniform thickness of ½ inch. When the roadway ballast had been filled in, the total settling of the arch amounted to 4.7 inches. The thickness of the arch at the apex is 19.7 inches, and at the springing line 27.5 inches. The bases of the abutments are 11.5 feet wide, and are 8.2 below low water mark. The strains upon the ends of the arch were partly taken up by smaller arches. The greatest admissible compressive strains in the structure amount to 66.14 pounds per square centimeter. The cement used showed a crushing strength of from 35.27 to 39.7 pounds after seven days, and from 48.5 to 52.9 pounds after twenty-eight days. The concrete used for the abutments was made up of one part cement, two parts of sand, six parts of gravel, and ½ part of limestone rock broken into pieces weighing from twenty-two to forty-four pounds each. The concrete for the springers and lower parts of the haunches of the arch was composed of one part cement, 1.25 parts of sand, and three parts of gravel. With the exception of the sand, of which only one part was used, the same proportions were retained for the part near the crown of the arch. The gravel used ranged between the sizes of a walnut and of an egg, and was carefully washed. The ramming of the concrete was done in layers 31.5 inches thick. The centering was left undisturbed for two months after the arch had been constructed.—*Engineering News.*

CAUSE OF STREET RAILWAY ACCIDENTS.

In street railway management, as in the operation of steam roads, it is largely the small details that must be watched to prevent accident. It is all in vain to maintain the most careful inspection of machinery and wheels of locomotive and train if the same care is not taken of switches and an hundred other places. The manager may equip his car with the most approved brakes and fenders, and yet overlook the steps over which every

passenger must pass twice during every ride. The number of accidents occurring to passengers while boarding or leaving a car will undoubtedly outnumber those arising from all other causes combined. Hence to carefully make a study of step and hand rails is one which may well engage the time of the busiest superintendent. We have seen steps on street cars which the directors would consider a constant source of danger if built into a flight of stairs in their residence. Such roads are, of course, exceptions, nevertheless it can do no harm to watch your steps and determine as to whether or not you are as fully protected as may be.—*Street Railway Review.*

A NEW STORAGE BATTERY SYSTEM OF TRACTION.

Despite the somewhat discouraging results which have attended the introduction of various storage battery systems during the past few years, inventors have not ceased to work in this line, and there are now before the public several systems which claim and are worthy of attention. Perhaps the latest claimants to the invention of a practicable system of storage battery traction are Messrs. Soley & Perkins, of Frankford, Philadelphia, Pa.

It has been the aim of the inventors to take everything out of the hands of the motorman, except one simple switch for starting or stopping the motor, so that however careless he may be no disastrous effects can result. The motorman has perfect control of the car by means of two levers, one of which governs the speed, and the other manipulates an exceedingly powerful brake. The car is equipped with one 20 h. p. motor, which runs constantly, but which can be shut off when descending a grade. When ascending a hill the motorman has at command two trains of gearing, one giving a speed of from zero to four miles per hour, and the other from zero to twelve miles; both, however, retaining the feature of single reduction. It has been estimated by prominent authorities that it requires about 9.6 h. p. to move an ordinary sixteen foot car fully loaded and weighing 8,000 pounds up a six per cent. grade at the rate of four miles per hour. This means 35.8 amperes. Allowing sixty per cent. loss, it would take 57.2 amperes for the batteries to furnish. This is well within the limits of the secondary cell. The difficulties with previous storage battery systems has been, Messrs. Soley & Perkins claim, that in ascending heavy grades a discharge of 175 to 200 amperes has been required, which is an unreasonably heavy discharge and can only result in the heating, buckling and destroying of the plates and active material of the cell. This invention, however, is claimed to obviate all these difficulties, and to present a good solution of this difficult question.

The invention of Messrs. Soley & Perkins has been placed in the hands of several capitalists in Frankford, Philadelphia, Mr. James Wolstencroft, of Wolstencroft & Co., being president of the company, and Mr. William O'Neil, treasurer. A full sized model has been built, and active steps are being taken to push matters ahead as rapidly as possible.—*The Electrical World.*

MACHINERY AND TRADE.

IMPROVEMENTS IN A BRICK MACHINE.

It is comparatively only a few years since the ordinary type of an upright brick machine has been accepted as a success. A few years ago the horizontal tempering machine called a "pug-mill" was invented, and has been largely used as an auxiliary to the steam-power machine, and has proved its value in doing away with the soak-pit process. It is customary to attach these pug-mills to the brick machine, letting them deliver the clay directly into it.

It was soon seen that these two machines could be combined into one single machine, which would be advantageous in many respects, and quite promptly several horizontal machines were invented and marketed, but the makers met new problems, which the other styles of machines had not brought to light, and these problems being too serious for them to solve satisfactorily, a large majority of the machines never got beyond the experimental stage.

The Wellington Machine Company were among the first to start an upright machine. They have developed it from a crude state until they now think they have one that is about perfect. The accompanying illustrations show two open-top pug-mills, each seven feet in length, placed side by side.

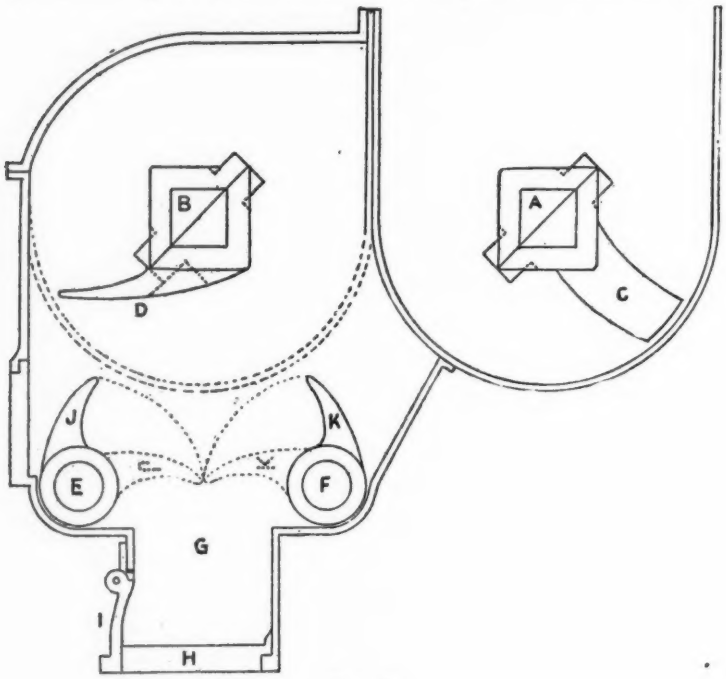


FIG. 1.

The clay is fed at the right-hand end of the rear one at the point marked C in the plan, and the tempering blades carry it in the direction of the arrow to the left-hand end of the pug-mill, where wipers take it through into the

right-hand end of the front pug-mill at D, where seven wipers on this front shaft force it downward between the presses and into the press-box. The pressure is applied at the right moment, forcing the clay through a die of the usual pattern into the molds, which are ejected in the usual manner.

The presses consist of heavy wings, J and K, cast on four-inch round steel shafts E and F. Their movement is oscillating, having the motion of a quarter circle, as shown by the dotted lines. They stand open and facing each other while the wipers on the shaft B fill below and between them. The material is fed to the presses with ease and surety. The front tempering shaft is directly over and parallel with the presses, and runs three revolutions to each mold of brick. The blades on the left-hand portion of this shaft are given the proper pitch or bevel to keep that part of the pug-mill over the presses completely with the clay. Then directly over the presses the shaft carries seven wipers, D, which force the clay down between the presses.

When the pressure is put on by the operator at the front of the machine, the presses move, both at the same time, as shown by the dotted lines, to the lower position, also shown by the dotted lines. This forces the clay downward through the die, H, into the molds below. The presses remain in the lower position until the mold has been ejected, when they return promptly to the upper position, and there stand wide open until again filled.

In the first machine of the Wellington people the face of the press came within four inches of the die. The results were not satisfactory, and they studied to see what was wrong. They tried the next machine with the face of the press six inches from the die, and, getting better results, increased this distance in each succeeding machine until now, in the pressing chamber G, it is nearly fifteen inches from the die to the face of the presses when in their lowest position. This gives a large body of clay between the presses and the mold, and insures at all times *an absolutely even and perfect distribution and equality of pressure on each brick*. The deep press-box also avoids danger from trouble with large stones or other obstructions getting between presses and dies, that occasionally do get in machines through gross carelessness.

On the right hand end of the rear shaft is a disc, with steel wrist-pin carrying an arm reaching to a "bell crank," or loose arm supported at the end of the front press-shaft. The loose arm is given a reciprocating motion of a quarter circle. On the press shaft is rigidly attached a notched casting, the edge carrying the notches also being a quarter circle. The loose arm carries a "dog" pivoted at the rear end. The regulating handle at the front of the machine is connected with a casting, by means of which this dog is kept entirely out of the notches, or allowed to drop into any particular notch required. The regulating handle has a spring clutch, such as is commonly used on agricultural machinery, whereby the placing of this clutch in the notches of the casting by the side of it, engages the "dog" in the corresponding notches on the regulating arm. Right here are two little points that are of value, and contained in no other device. The regulating arm is always stationary, and the pressure can be changed at any part of the stroke of the press. In all others the regulating device is in motion, and the

man in regulating the pressure has to follow its motion with his hand, and also watch the motion of the press to catch some particular moment when the pressure can be changed.

SAFETY DEVICES.

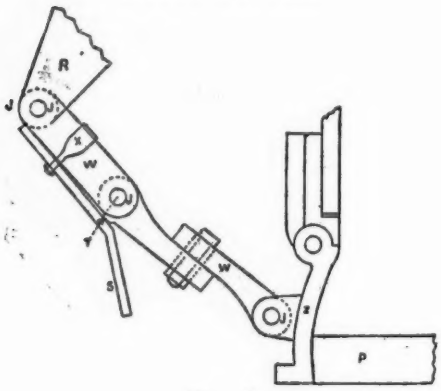


FIG. 2.

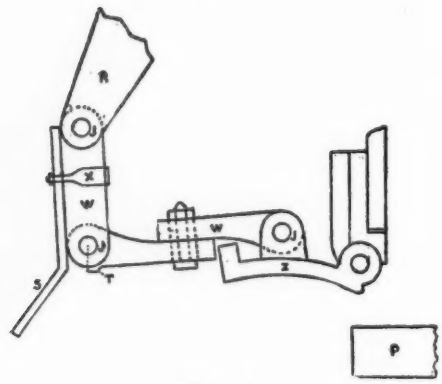
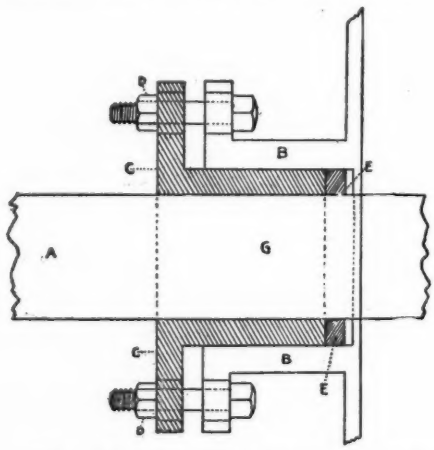


FIG. 3.

The stone relief door is a little gem of mechanical ingenuity and perfection. The toggle principle is used. In the figures 2 and 3, R is the lug to which the upper joint is hinged. W W are the arms making the toggle. J J J, the joints of the toggle. Z, the door. P shows a side view of the end of the die. S, the spring, and X, a movable clip regulating the tension of the spring, and T the small lug or projection on the lower arm of the toggle. When the door is shut as in Fig. 2 the door is rigidly held to place, but as the middle joint is set just a little outside of a straight line between the other two joints, any dangerous pressure will force the door open into the position as shown in Fig. 3. Whenever the operator wishes to open one or more of the doors he takes hold of the handle part of the spring, S, and pulls towards him, and a very slight pull on this will open the door, while a very heavy pressure on the door itself is required to open it. It will be noticed that the lower arm of the toggle consists of two pieces. These are slotted and held by a bolt, allowing the lengthening of this arm as the edge of the door wears off.



The above is a section showing the stuffing-box as used at the four places where the press shafts pass through the main heads. A is the shaft, B the head, C the stuffing-gland, D D the bolts for tightening, and E the packing. By use of this device the mud and water is perfectly and absolutety kept from the bearings and wearing surfaces. Also, again refer to the small plan drawing accompanying the large cut. This shows the location of bearings and stuffing-boxes for the

pug-mill shafts. Note that the bearings, A, are located entirely outside the head, and the stuffing-box, B, is at the point where the shafts pass through the heads. They are simply regulated by the bolts on the outside of the head.

It is claimed that these machines will mold brick at the stiffest possible consistency that is practical, and fill them all perfectly square. The machines are made by the Wellington Machine Co., of Wellington, O., of which C. McDermott is secretary.

GOOD POINTS OF A STREET SWEEPER.

It is claimed for the Champion street sweepers that they will move from two to four inches of wet mud street accumulations into windrows with one team of horses to each machine; that they will clean street car tracks of snow three to six inches deep; that they will leave the streets cleaner than the most careful work done by hand, shovels and brooms, at one-tenth the cost of the latter; that they will sweep equally well on asphalted, blocked, cobble-stoned, macadamized, and brick-paved streets; that one steel broom in constant use will wear from ten to fourteen weeks, and will outwear from ten to twenty of the usual rattan brooms; that in short the machines will save their cost, broom and all, in half the first year's use. The frame of the machine is of clear and thoroughly seasoned hard wood, which affords the advantage of making them much lighter, and more durable than can be done by using ordinary lumber and an iron frame. All the parts of both cast and wrought iron are faced wherever there is any friction. Some sweepers are so constructed that the bearings and journals of all the shaftings are always binding against one another, resulting in a continual wearing and breaking. In the "Champion" this difficulty is overcome by the introduction of a self-equalizing balance bar, which allows the sweeper, while at work, to adjust itself to any inequalities in the roadway, causing each bearing to do its own work. The most effectual point about the "Champion" machine is that the power used is secured "direct from the driving point," to the end of the brush, from which the most work is expected, without the intervention of any counter-shafts or the transmission of power. The gearing of some sweepers is underneath the platform, close to and in front of the broom, thereby exposing it to all the dust and dirt which is thrown up by the revolutions of the broom, causing a cutting away of the gear wheels and journals, also constant and unnecessary wear of the machinery to such an extent that, in constant use, it is necessary to renew the gearing about once a month. In the "Champion" the bearings and journals are properly boxed and covered—the only gearing about the machine being two small pinion gear wheels on the end of the shaft and practically behind the broom, and the bearings of these and the wheels themselves are covered, thus protecting them from all dirt and dust, and they will, consequently, wear longer and easier.

AN IMPROVED BRICK MACHINE.

The catalogue of the Decatur Leader Manufacturing Company, of Decatur, Illinois, for 1893, is out. In introducing it, the proprietors state that they have spared neither expense nor effort to bring their machinery up to the highest

standard of excellence. They have made many improvements during the last year, which are shown in the cuts in their new catalogue. Special attention is direted to their largest and heaviest brick machine with automatic cutter, separator and sander, which they claim is complete in every detail and mammoth in weight and strength. They describe it thus:

"Among its many conveniences are friction clutch pulley, operated from any point, roller feeder in hopper, hinge and safety-pin at die end to avoid breakages, improved double end thrust bearings, either lubricating or dry dies, forged steel augur shaft five inches at largest diameter, all steel shafts, powerful gearing, ample bearings, perfect lubrication. The tempering knives are in pairs clamped on shaft and may be removed independent of the rest. Hard iron screw or augur carefully ground. Dies and attachments may be had for making side cut bricks, hollow blocks, such as fire-proofing, building blocks and drain tile. A machine of this size is usually rated at fifty to eighty thousand brick per day of ten hours. We prefer to underrate rather than overrate its capacity, believing it will not diminish the number of our sales and that our patrons will feel that our goods will come fully up to their expectations at all times and under favorable conditions greatly exceed them. We guarantee 35,000 brick per day of ten hours under ordinary conditions; with good clay, well prepared, 50,000 brick, and recommend fifty-horse power. The machine without cutting table occupies a floor space of six feet four inches by thirteen feet with automatic cutter six feet four inches by twenty-seven feet to off-bearing belt, which is twelve feet long unless extra length is ordered; with side cut die and board delivery table six feet four inches by twenty feet.

"The driving pulley is fifty-four inch diameter by twelve inch face, and should run about one hundred and fifty revolutions per minute. Height to top of hopper, fifty-two inches. Height over all, sixty-one inches. Estimated weight, 12,000 pounds. For paving, foundation, and sewer brick, a dry die is preferred, owing to the fact that it offers more resistance and compresses more clay into the brick than lubricating dies. For building and general purpose brick a lubricating die is preferred because the bricks are not so dense, require less power to operate the machine and dry and burn quicker."

Much information is given regarding the other clay-working machinery of this firm, together with illustrations.

NOTES.

Carroll, Vick & Co., Toronto, Ont., will erect a shale paving brick plant.

The Hocking Clay Manufacturing Company, Logan, Ohio, has just contracted with the Frey-Sheckler Company, for one of their double die steam-power repressing machines.

The Frey-Sheckler Company, Bucyrus, Ohio, have just closed a contract with T. M. Walker, of Des Moines, Iowa, for a complete plant of machinery, also dry house for the manufacture of paving brick. The outfit consists of the following: No. 1 Bucyrus Giant Brick Machine, with automatic cutting table; No. 5 double gear pug-mill, two nine-feet diameter all iron and steel

dry pans, one hoisting drum, clay cars, elevators, tailing's crushers, dump cars, all transmitting machinery and a Bucyrus Steam Tunnel Drier of 50,000 daily capacity.

The H. Nichols Company, New Lexington, Ohio, has just contracted for a complete set of machinery from The Frey-Sheckler Company for a capacity of 50,000 brick daily. The outfit consists of one of their largest machines, compound crusher, pug mill, cutting tables, etc.

The Galesburg Brick and Terra Cotta Company, Galesburg, Ill., has just contracted with the Frey-Sheckler Company, of Bucyrus, Ohio, for one of their Bucyrus Steam Tunnel Driers, 90,000 daily capacity. This will be one of the largest steam tunnel driers in the west.

The Canton Brick Company, Canton, Ohio, has just purchased a complete outfit of machinery from the Frey-Sheckler Company, including a No. 1 Bucyrus Giant Brick Machine, Wellsville Side-cut Table, tailing's crusher and one double die steam-power repressing machine.

The relative economy of different street pavements depends, it is evident, upon the cost of maintaining the pavement in good order for a period of years, and not, as is too often assumed, on the first cost, or the life of the pavement. Some interesting figures bearing upon this subject will be found in the advertisement of the Warren-Scharf Asphalt Paving Company, in this issue.

The Frey-Sheckler Company has supplied the Canon Brick and Tile Manufacturing Company, Canon City, Colo., with one of their nine-feet diameter all iron and steel dry pans and No. 5 pug-mill.

The Frey-Sheckler Company, Bucyrus, Ohio, has recently sold a complete outfit of their machinery to the J. Switzer Pressed Brick Company, Blossburg, Mont., comprising a No. 2 Giant Brick Machine, Wellsville Cutting Table, one nine-feet diameter all iron and steel dry pan, No. 5 double gear pug-mill and one of their double die steam-power repressing machines.

The Frey-Sheckler Company has just sold a complete plant of machinery to J. Meeks, Briggs & Co., Superior, Neb., for their new paving brick plant to be erected at Table Rock, Neb. The outfit consists of one of their large Giant machines, automatic cutting table, two nine-feet diameter dry pans, No. 5 pug-mill, tailings crusher, screens, 100 horse-power engine and two 75 horse-power boilers.

A movable earth and rock excavator, 300 feet long, having a cantilever arm projecting over the waste bank 120 feet, is being designed by Mr. Henry Goldmark, M. Am. Soc. C. E., of Chicago, for use on the drainage canal of the Sanitary District. It consists of a Howe truss span, supported by two towers, 40 feet high, placed on each side of the cut. Two cars of five yards capacity each will be raised and transported at a time. Its estimated capacity is 700 cubic yards per hour.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

The annual appropriation bill in Worcester, Mass., includes $100,000 for highways, $45,000 for streets, and $16,000 for parks.

City Engineer Doremus, of Salt Lake City, has mapped out a ten-mile boulevard. The report submitted by him to the council was referred back for an estimate of cost of construction.

B. R. Morton, city engineer of Newport, Ky., writes that bids were invited for brick streets and the construction of sewers, but a question having arisen as to the validity of the bonds proposed to be issued, the same were recalled until a test could be made.

A committee representing the select and common councils of Erie, Pa., has recently made a brick pavement investigating trip. The party visited Youngstown, Canton, Pittsburgh, Wheeling, Columbus and other cities where brick pavement has been adopted for use instead of stone or asphalt. The Erie gentlemen were surprised to learn that concrete foundations are not in use in the cities visited. Slag from gas-houses and broken stone are considered better than concrete.

The report of F. A. Dunham, city engineer of Dunkirk, N. Y., for the street work done during the last two years, shows the construction of 7,229 feet of sewers, from ten to fifteen inches in diameter, at a total cost of $8,745.59; the construction of 48,423 square yards of brick pavement, with concrete foundations, at a cost of $130,904; 7,433 square yards of brick pavement with broken stone foundation at a cost of $16,621.07, and 28,857 square yards Telford-macadam pavement at a cost of $47,686.36.

CONTEMPLATED WORK.

Arcola, Ill., is still talking of paving her streets.

Lewistown, Mont., is agitating the paving question.

There is talk of paving La Porte street, Plymouth, Ind.

Park Avenue West, Mansfield, Ohio, will probably be paved.

W. D. Riddell of Xenia, Ohio, reports an active discussion of the street paving question in that city.

Plans are being made for the paving and sewering of Main street, Clyde, O.

Yamhill street, Portland, Ore., will probably be paved with asphalt or bituminous rock.

Ninth and Fifteenth streets, Kansas City, Mo., will probably be paved with asphalt.

Wichita, Kan., is preparing to tear up her Jasperite pavements and lay asphalt in their place.

Monroe, Mich., has issued $25,000 worth of bonds to do paving with during the coming summer.

L. E. Browne, city engineer of Richmond, Ind., writes that considerable macadamizing of streets is to be done in that city during the summer.

The Indianapolis, Ind., board of public works has decided to make some experiments with granite paving on Georgia and South Meridian streets.

The city clerk of Warsaw, Ind., writes that the question of paving streets this season is being discussed, but nothing definite has been decided upon yet.

City Engineer Place, of Cortland, N. Y., writes that as soon as the sewerage question is disposed of the village will adopt some definite plan for street improvement.

Geo. T. Day, city clerk of Union City, Ind., writes that the street paving question is being agitated by the property-owners. Several streets will be graded and graveled this season.

An active discussion of the paving question is in progress in Des Moines, Ia. A number of streets are to be paved, and a selection of the kind of pavement to be used is yet to be made.

The appropriations already made by the council of Baltimore, Md., for street paving this year, amount to a little over $1,200,000; and additional appropriations to the amount of $1,000,000 for repaving, will probably be made.

Riverside avenue, from Monroe to Division street, Spokane, Wash., will probably be paved with granite blocks at an estimated cost of $70,000. Howard street, from Sprague to Main avenue, is to be paved. Work on other streets is contemplated.

H. H. Wagoner, city enginer of Huntington, Ind., reports that street improvements there may include the extension of Division street to First, the widening of First street, and the improvement of Jefferson and Lafontaine streets.

The amount of paving which will be done in Buffalo, N. Y., this year will slightly exceed that of last year, during which twenty-four miles of streets were paved, at a total expense of $1,268,310.52. The pavements are to be principally asphalt.

The Philadelphia Common Council has appropriated $400,000 for the purpose of repaving small streets with asphalt. This is an effective step in the direction of keeping the city clean and of lessening the danger of disease in the poor and populous districts.

From $12,000,000 to $15,000,000 will be spent for public works under the special assessment system in Chicago this year. The commissioner of public works has already let eight hundred contracts for street improvements, the aggregate cost of which will be about $3,000,000. Contracts involving a much larger amount are yet to be let. This will include asphalt, cedar block, macadam, and granite block pavements.

It is reported that plans are in preparation looking to the parking of Grant avenue, Denver, Colorado, throughout its entire length. The contemplated improvements include the construction of two macadamized driveways, each twenty-five feet wide. Between the driveways a space fifteen feet wide is to be set apart for a lawn, in the center of which a row of shade trees is to be planted. Trees will also be set on either sidewalk, so as to make the avenue one of the most attractive residence streets in Denver.

CONTRACTS TO BE LET.

Lima, Ohio, will pave the public square with brick.

Third street, St. Paul, Minn., is to be repaved this summer.

About twenty streets of Milwaukee, Wis., are to be paved with cedar blocks.

The Norwood, Ohio, council has voted to advertise for bids for improving three streets.

Parts of Glessner avenue, Park avenue and Bowman street, Mansfield, O., are to be paved.

West Main street, from the Ohio canal to the west line of Henry street, Massillon, O., will be paved.

The board of public works of Knoxville, Tenn., has been instructed to advertise for bids for brick paving.

The Ottawa, Ontario, Board of Public Works has voted to pave Rideau street with asphalt, at a cost of $70,000.

Ordinances have been passed for the grading, draining and improving of Paulin and Lydia streets, Youngstown, O.

A. B. Phillips, of Ashtabula, Ohio, writes that contracts for 10,000 square yards of brick paving will be let about May 1.

The city engineer of Albany, N. Y., is preparing estimates for paving in nine streets with granite blocks, and one with asphalt.

East Berry street, Ft. Wayne, Ind., from Barr to Monroe streets, a distance of about 1,200 feet, is to be paved with brick or asphalt.

The city clerk of Marshalltown, Ia., will receive bids until April 10 for 27,317 square yards of brick paving and 10,640 lineal feet of stone curbing.

Asphalt paving to cost about $45,000, has been ordered at Pasadena, Cal. The estimated cost of the paving is twenty-five cents per square foot.

Proposals will be received at the office of the commissioners, Washington, D. C., until April 13 for furnishing granite curbing and granite paving blocks.

The Milwaukee, Wis., Board of Public Works have a list of about twenty streets to be graded, curbed and paved this season. Stone curbing and cedar blocks will be used.

A new paving ordinance in Pekin, Ill., provides for the paving with brick of Court street from Front to Fifth; and Capitol and South Fourth streets, from Court to St. Mary's.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will be received in the near future for a brick street pavement five blocks long, about 5,200 square yards, and for about 2,700 lineal feet of stone curbing.

Resolutions have been passed by the city council of Canton, Ohio, for the improvement of North Market street by paving roadway with vitrified street paving brick on a broken stone foundation; also for brick paving on concrete foundation on Eighth street.

Bids will be received until April 14th, for curbing and paving in Ashville, N. C., requiring about 11,000 feet of curb, about 20,000 square yards of granite paving and about 14,000 square yards of macadam; also for curbing and paving with granite, or bricks, Haywood street from Patton avenue East to Patton avenue West, about 12,500 square yards of pavement and 5,500 feet of curb.

C. S. Rapp, city recorder of Ogden, Utah, writes that proposals will be let this month for paving Twenty-fifth street with Utah sandstone and asphaltum.

Resolutions have been passed providing for the granite curbing and bituminous rock paving of Grove street between Octavia and Laguna streets, in San Francisco.

City Engineer Morrison, of Tacoma, Wash., has submitted to the board of public works an estimate for the paving of Pacific avenue with bituminous rock, from Seventeenth to Twenty-fourth streets. The total cost is placed at $70,000.

Ordinances have been passed for vitrified brick paving in Louisville, Ky., on portions of Barrett, Avery, Camp, Floyd, Madison, Maple, Speckert and Twenty-second streets and for boulders on one block of Washington street. Ordinances for the improvement of various sidewalks and alleys were also passed.

T. L. McConnell, city book-keeper of Lexington, Ky., writes that the general council has accepted the plans and specifications of the surveyor for the reconstruction of the roadway of High street from Rose to Maxwell street, a distance of about one and one-half miles, with asphalt. The bids are now to be entertained.

Forty-nine streets or portions of streets in Cleveland, Ohio, will be repaved this season, making a total of over sixteen miles, at a cost of $1,198,100. Most of this paving will be done with dressed block stone, while brick and common Medina block will be used for a large percentage. Four streets will be paved with asphalt.

Twelve miles of street paving will be laid in Dayton, Ohio, during 1893. The work on some of the streets to be improved will be let early in April and the other streets will follow in rapid succession as ordinances can be passed and published and the necessary advertising for proposals be completed. The board of city affairs will authorize paving this year amounting to about $800,000. There is much discussion and diversity of opinion as to the material to be used.

The property owners on East Burnside street, Portland, Ore., will put down a plank roadway. The planks are to be sawed so that they are three inches thick at the curb and five inches at the other end, making the roadway five inches thick in the middle. It is said that planking laid in this way will last four or five years in good condition, and by the time it is worn out, all pipes and sewer conduits will be laid and the property owners can proceed to improve the street in some substantial manner.

Streets ordered paved in Burlington, Iowa, include North Eighth, South Tenth, Smith and North streets, and Central avenue. The city council has appropriated $10,000 for street paving this year.

CONTRACTS AWARDED.

McIntyre & Wickham have the contract for paving Blake street, Denver, Colo.

The Acme Paving Co., of Indianapolis, has been awarded the contract to pave Jefferson street, Franklin, Ind.

Henry Vogel, of Helena, Mont., has secured the contract for paving with brick, Central avenue in Great Falls, Mont.

J. H. Bain, of Goldsboro, N. C., writes that a contract has been made for 2,000 tons of shell rock for street paving purposes.

The contract for the Fulton street pavement, Toledo, O., has been let to the Warren-Scharf Asphalt Paving Company for $377,54.88.

E. L. House has been engaged to make estimates and do the engineering work on the State street paving, Painesville, Ohio, for a consideration of $500.

C. F. Lane writes that Herring & Straub, of Mansfield, Ohio, have been awarded the contract for brick paving in Berea, Ohio. There were sixteen bidders.

The Winona Construction Co. have secured a contract for paving thirty-seven blocks of business streets in Winona for $118,430. Galesburg brick will be used.

L. E. Chapin, city engineer of Canton, Ohio, writes that McKinney & McNichols have the contract for grading Cedar street, 23,300 cubic yards, at 19 cents per cubic yard.

Jacobs & Stewart, of Norwalk, O., have secured the contract for the paving of Market street, Sandusky. Their bid ranged from $7,435 to $9,266, according to the style of paving.

J. W. James, of Sioux Falls, S. Dakota, writes that about one mile of two-inch pine six-foot sidewalk, has been contracted for at from thirty-three to thirty-five and one-half cents per lineal foot, and 600 feet of twelve-foot walk, at sixty-eight cents per lineal foot.

F. M. Shangle, city clerk of Oskaloosa, Iowa, writes that a contract for five blocks of street paving has been let to N. S. Young. The prices were as follows: Brick paving, including grading eleven inches, $1.65 per square yard; cement curb, fifty-six cents per lineal foot; reset cement curb, twenty cents per foot; brick curb, twenty-five cents per foot; excess grade, thirty cents per cubic yard.

Austin Ford & Son, Cambridge, Mass., have the contract for 2,500 feet of North River flagging at 37½ cents per square foot, delivered on the streets. The other bids were the New England Stone Co., Cambridge, 43 cents per square foot, and J. J. Cuddihy & Co., Boston, 41 cents per square foot.

Fred Hohmann, village clerk of Blue Island, Ill., reports that the contract for curbing and paving Western avenue, from Stony creek to Burr Oak avenue, was let to John V. McAdams at 80 cents per lineal foot for 5-inch limestone curbing and $1.17 per square yard for 8-inch cedar block pavement.

The following contracts have been awarded in San Francisco: For grading and macadamizing Iowa street from Yolo to Nevada, James McCoy, $4,000; for paving with bitumen the crossing of Fair Oaks and Twenty-second, City Street Improvement Company, $732; also, the crossing of Gough and Myrtle avenue, $570; stone sidewalks on Fulton from Broderick to Baker, Flinn and Treacy, $350.

Henry Kelling, city clerk of Walla Walla, Wash., writes that L. R. Hawley has been awarded the contract for improving Dr. Newell street, from Howard to Catharine, for $1,850 and surplus earth. The work calls for 3,124 cubic yards excavation, 1,171 cubic yards embankment, 3,196 lineal feet sidewalk six feet wide, 92 lineal feet sidewalk twelve feet wide, 3,384 lineal feet curbing, 112 lineal feet drain boxes, 1,753 lineal feet strawing fifty-six feet wide.

The following contracts for paving have been awarded fn Kansas City, Mo.: Charlotte street, from Fifth to Sixteenth, Barber Asphalt Co., $2.50 per square yard; Eighteenth, from Grand to Main, with Diamond vitrified brick, F. P. McCormick, $1.93 per square yard; Holly, from Seventeenth to Eighteenth, Barber Asphalt Co., $2.50 per square yard; Third, from Grand to Wyandotte, with Diamond vitrified brick, F. G. Trestrail, $1.39¾ per square yard.

George H. Fister, city clerk of Elkhart, Ind., writes that the council has awarded the contracts for paving Jackson street, Second street, and Tyler avenue, Harrison, Marion, Franklin, High and Pigeon streets, between Main and Second streets, to A. F. Nims of that city. The bid for paving Jackson street with Canton Malvern fire clay brick on a crushed stone foundation, the interstices between the brick to be filled with Portland cement, was as follows: Vitrified brick pavement complete, $1.59 per square yard; curbing set complete, forty-three cents per lineal foot; filling, five cents per cubic yard; excavating, twenty-three cents per cubic yard. The pavement on the other streets is to be the same, with the exception of a gravel instead of crushed stone foundation, and will cost $1.37 per square yard.

Contracts for brick paving in Evansville, Ind., have been awarded as follows: Minnehaha Granite Co., Indianapolis, Washington avenue, from Parrett to Garvin streets, $1.75 per square yard; Fifth street, from Sycamore to Pennsylvania streets, $1.70 per square yard; Second street, from Bayless to Emmett streets, $1.67 per square yard. James Nugent, Division street, from Second to Third streets, $1.66 per square yard, and Ingle street, from Water to First avenue, $1.67 per square yard.

E. H. Reed, superintendent of streets, of Cambridge, Mass., writes that Austin Ford & Son have secured the contract for 15,000 feet edgestone. The bidders were: F. J. Fuller, Quincy, straight, 53 cents per foot; circle, $1 per foot. Jeremiah McCarthy, Somerville, straight, 48½ cents; circle, 74 cents. Wight & Scorgie, Cambridge, straight, 50 cents; circle, 78 cents. S. & R. J. Lombard, Charlestown, straight, 48 cents; circle 73 cents. Austin Ford & Son, Cambridge, straight, 46 cents: circle, 75 cents.

SEWERAGE.

Deering, Me., is in great need of a better public sewerage system.

The citizens of Alexandria, Va., are agitating the sewerage question.

The question of surburban sewerage drainage is agitating the citizens of Memphis, Tenn., suburbs.

The sewage at Los Angeles, Cal., will be emptied into the ocean by means of a main sewer seventeen miles long.

Marsden Manson and C. E. Grunsky are the engineers engaged in devising a sewer system for East Oakland, Cal.

E. L. House has been engaged by the council of Painesville, O., to make estimates and do the engineering work on the Erie-street sewer for $250.

Donald McLeod, who has the contract for building the Washington street and Alabama street main sewers in Indianapolis, has begun work on the Alabama street sewer.

Three ordinances have been compiled by City Attorney Williams, of Denver, Colo., for the construction of the sewer approved by the board of aldermen. For the North Denver sewer No. 2 the estimated cost is $112,000, for the South Denver sewer, $126,000, and the short sewer connecting the latter with the Capital Hill sewer, $3,500.

Williams & Ulrich, of Springfield, O., are building a large trunk sewer at Richmond. It is heavy rock work, the deepest cut being 33½ feet. The work will be completed by the first of May.

The largest cement sewers made in the United States, of which there is any record, were made in Galveston, Tex., for the Twentieth street sewer. These are forty-two inches bore, three feet long, and weigh about 2,000 pounds each section.

CONTEMPLATED WORK.

Huntsville, Tenn., is discussing the sewerage question.

Cairo, Ohio, proposes to put in a system of sewers this season.

Alliance, Ohio, voted four to one in favor of extending the sewerage system.

Auburn, Cal., is considering the investment of $20,000 on a sewerage system.

The ordinance has been passed for building a sewer in Walnut street, Peoria, Ill.

The Maquoketa, Iowa, city council is considering the establishment of a sewerage system.

The question of sewerage and other public improvements is being introduced at Lockland, Ohio.

The Salt Lake City, Utah, council has appropriated $300,000 for the proposed gravity sewer system.

L. E. Browne, of Richmond, Ind., reports that some sewer work will be done in that city during the summer.

Colonel Delafield, of New York has charge of a force surveying for a new sewerage system for Palestine, Texas.

The movement for a system of sewers in Rome, N. Y., has taken form and the adoption of the plans will be voted upon by the tax-payers.

Menasha, Wis., thinks of building a sewer a mile long, to empty into Lake Winnebago. The cost of the proposed work is estimated at $12,000.

North Andover, Mass., has accepted the report of the Committee on Sewerage recommending the adoption of a system to cost about $44,000.

Plans have been prepared at Newark, N. J., for sewers estimated to cost about $175,000. The city surveyor recommends that a part to cost $108,000 be constructed as soon as possible.

Frank Place, city engineer of Cortland, N. Y., writes that the sewer commissioners will submit to popular vote a proposition for the construction of a system of sanitary sewers in that village.

J. Wesley Wright, clerk of Bristol, Pa., writes that efforts are being made to have the state legislature repeal the debt-limiting clause of the Boro Charter, so as to erect a public sewer at a cost of about $50,000.

T. H. Bain, of Goldsboro, N. C., writes that a vote will probably be taken about the first of May, on the question of issuing bonds to the amount of $50,000 for a system of sewerage and other public improvements.

Frederick P. Stearns, chief engineer of the Massachusetts Board of Health, has been requested by the West Side sewer commissioners of Rochester, N. Y., to revise the plans for the proposed sewer on the west side of the river.

An order was passed by the board of aldermen of Brockton, Mass., authorizing a loan of $285,000 to be used in the construction of the sewerage system. The common council concurred with the board of aldermen in authorizing the sewerage loan.

City Surveyor Adams has submitted two sewerage plans for the eastern part of the city wards at Newark, N. J. One plan is to run a main sewer from the intercepting sewer at Avenue I, through Avenue I, Jabez street, Berlin street, Manufacturers' lane, Ferry street to the Plank road, to Lockwood street. The fall will be 8½ feet. The other plan provides for a main sewer from Horatio street to Freeman street and Passaic avenue.

Plans and specifications have been prepared by the city engineer of Indianapolis for the Mississippi street trunk sewer, from Merrill street to St. Clair; thence to Meridian, thence to the first alley north of St. Joseph street, thence east to Delaware street, thence north to Home avenue, thence east to Central avenue, thence north to Seventh street. Length 14,466 feet; sizes eight feet to twelve inches circular.

CONTRACTS AWARDED.

Contracts have been awarded for a general system of sewers at Modesto, Cal.

Red Jacket, Mich., has let the contract for a sewer system to cost in the neighborhood of $130,000.

Frank L. Allen, of Worcester, Mass., has the contract for building eight miles of sewers for the town of Bennington, Vt.

Twenty-two thousand four hundred and twenty-one dollars worth of new sewers has been contracted for at Monmouth, Ill.

Contracts have been awarded at St. Paul, Minn., to P. Doherty for a sewer on Grand avenue; Hansen & Johnson, on Milton street and Hague avenue; Patrick Thornton, on University street between Grotto and St. Albans street.

CONTRACTS TO BE LET.

The Philadelphia city council has voted to construct sewers in thirty-two streets.

W. H. Caldwell, of New Britain, Conn., has prepared plans for a sewerage system for Plainville, Conn.

A. B. Phillips, clerk of Ashtabula, Ohio, writes that sewer contracts for two streets will be let about April 20.

Sioux Falls, S. D., is about to let the contract for constructing thirteen miles of sewerage, at a total cost of $325,000.

L. W. Fogg, engineer for Latrobe, Pa., writes that several large sewers will be built this year. Plans have been adopted.

W. J. Miller, city clerk of Ann Arbor, Mich., reports that the city has voted to issue bonds for $30,000 for the construction of a main sewer.

Le Mars, Ia., is considering plans for about twelve miles of sewers, estimated to cost $73,000. It is intended to commence the construction this spring.

Bids will be received by W. Ellwood Wynne, of Avondale, Hamilton county, O., until April 14, 1893, for the construction of sewers in Shillito street, Beach street, Borrman avenue, Savoy Place and Bowman avenue in District No. 2.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will soon be wanted for a 12-inch vitrified pipe sewer 250 feet long, and a 15-inch vitrified pipe sewer 750 feet long.

Sealed proposals will be received at Dayton, O., until April 10, for furnishing materials and constructing storm sewers and appurtenances. The work on which bids are solicited comprises about 2,632 lineal feet of sewer 6 ft. 8 in. x 8 ft.; 665 lineal feet of 6 ft. 1 in. x 7 ft. 3 in.; 1,335 lineal feet of 5 ft. 8 in. x 6 ft. 9 in.; 375 lineal feet of 5 ft.; 1,200 lineal feet of 4 ft. 6 in.

Bids will be received by the board of city affairs, until April 10, for the construction of storm sewers in the city of Dayton, O. There will be required about 6,207 lineal feet of sewers; 4,250 cubic yards of brick masonry; 1,300 cubic yards of stone masonry; 1,200 cubic yards of concrete masonry; 7,750 cubic yards excavation; 15,000 cubic yards backfilling; 20,000 feet of lumber; five tons of iron pipe, and other minor items.

WATER-WORKS.

The citizens of New Orleans, La., will soon have filtered water flowing through the mains. The plant is almost completed, and is one of the largest in the country.

Ten thousand feet of six-inch pipe and smaller quantities of four, eight, and ten-inch mains will be added to the water-works system at Holyoke, Mass.

The latest scheme of the authorities of Hamburg, Germany, to purify the town water supply is to erect machinery for the heating of the water in pipes to the boiling point before allowing it to pass along the distributing mains for consumption by the people. Both typhoid fever and cholera bacilli are killed before even this temperature is attained, and, by the adoption of this method, it is expected that the risks of either disease would be reduced to a minimum.

CONTEMPLATED WORK.

Water-works are talked of at Hubbard and Lockland, O.

Frankfort, Mich., is discussing the water-works question.

Sturgeon Bay and Waupaca, Wis., propose building water-works.

Fairport, N. Y., citizens have voted in favor of establishing municipal water-works.

About 1,300 feet of water main will be constructed on West Division street, Union City, Ind.

The people of Springfield, O., will make an addition to the equipment of the city water-works that will cost $125,000.

The water-works question is agitated at Milton, Ohio, Doylestown, Ohio, Frostburg, Md., Garfield, Wash., Buffalo, Wyo., Harriman, Tenn., Washington, Kan., Waupaca, Wis., Fowler, Ind., Doon, Ia., Centerville, Ia., Cascade, Ia., Grundy Center, Ia., Silver Plume, Colo., and Jacksonville, Texas.

M. M. Moore, clerk of the Columbus, Ga., council, reports that the council has appointed a committee to investigate as to the cost of water supply for the northern portion of the city. This may necessitate additional works, as the system now in use is on the gravity plan, and at present the pressure is not great enough to answer the purpose.

CONTRACTS AWARDED.

Moweaqua, Ill., has contracted for a system of water-works.

Greenfield, Ind., has contracted for a water-works plant to cost $40,000.

The contract has been awarded for water-works at Atlantic Highlands, N. J.

R. W. Havens, city engineer of Dallas, Tex., writes that the city has let the contract for twelve car loads of water-pipe to the Howard Harrison Iron Co., of Bessemer, Ala.

C. B. Talbot has agreed to furnish Tacoma, Wash., with a supply of 20,000,000 gallons a day pure mountain water for $852,500.

About two miles of water mains will be added to the water-works at Marion, Ind., John Cameron has the contract for doing the work.

The contract has been let to construct the extension of the city water-works system at Fairbury, Ill. Chas. T. Tobin, of Hillsboro, was awarded the contract.

The city council of Portland, Ore., has let contracts for the construction of a steel pipe line to carry water from Bull Run to Portland, a distance of thirty miles. The contract for supplying 11,442,000 pounds of steel plate was let to the Risdon Iron Works of San Francisco. The contract for cast-iron pipes was awarded to the Oregon Iron and Steel Company. The construction of headworks and bridges and the manufacturing and laying of steel pipes were let to local bidders, the whole amounting to $1,000,000.

WATER-WORKS CONTRACTS TO BE LET.

Topton, Pa., has voted in favor of water-works.

Barnesville, Ga., citizens have voted in favor of a water-works system.

Thomas Burress, Jr., city recorder of Jonesboro, Ark., writes that that city wishes to grant a franchise for water-works.

During the present year, the Cedar Rapids, Iowa, Water Company will expend $15,000 in pipes for the extension of mains.

Water-works will be built at Greenville, Darke county, O.; Norwood, O.; Fullerton, Neb.; Demopolis, Ala., and Martinsville, Va.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will be wanted in the near future for 1,700 feet of six-inch water main.

The town board of Cicero, Ill., has passed an ordinance providing for laying water pipes in Berwyn and La Vergne, which will cost about $57,600.

J. P. Wellman, city clerk of Keene, N. H., writes the city will soon receive bids for the furnishing of about one mile of twelve-inch iron water pipe, with the necessary Ts, gates and hydrants.

Sealed proposals will be received by Andrew G. Ankenbauer, clerk of the board of water-works and electric light trustees of the village of Reading, Ohio, until April 12, 1893, for three hundred tons of coated cast iron pipe 3, 4, 6, 8 and 10 inches internal diameter, six tons of specials, 50 fire hydrants, single nozzle valves; 11 8-inch, 7 6 inch, 9 4-inch, 9 3-inch, with stop boxes. Also proposals for trenching, laying and back-filling of the above pipe, and for setting hydrants, specials, valves and valve boxes.

New water mains will be added to the water-works system of Milwaukee, Wis.; pipes will be laid on the following streets: Chambers, from Fifth to Sixth; Holton, from Wright to Clarke; Ninth, from Chambers to Locust; Sixth avenue, from Maple to Windlake avenue; Bishop avenue, from Potter avenue to Superior; Lenox, from Homer to Deer; Lenox, from Kinnickinnic avenue to Russell avenue; Grove, from Rogers to Lincoln avenue; Twenty-second, from Fond du Lac avenue to Wright; Wilcox, from South Bay to the right-of-way of the North-Western Railroad in the Twelth Ward; Lee, from Ninth to Tenth; Park Hill avenue, from Thirty-first to Thirty-second; Murray avenue, from Park Place to Folsom Place.

BRIDGES.

Montrose county, Colo., is at present building three new bridges.

The Pacific Short Line is completing a new $1,000,000 bridge at Sioux City, Iowa.

Dayton, O., wants a new wrought-iron bridge to span Wolf creek at Broadway street.

A pontoon bridge over the Mississippi river at Burlington, Ia., is being agitated by the *Hawkeye*.

The question of building a bridge across the river at the foot of Post street, Spokane, Wash., is being agitated.

Plans have been drawn for a bridge across the Mississippi at Red Wing, Minn. The stucture will cost $70,000.

The project of building a bridge across Portage lake, between Houghton and Hancock, Mich., is again being agitated.

A bill has been introduced in congress authorizing the construction of another bridge across the river at St. Louis, Mo.

The bill bonding Cuyahoga county, Ohio, $160,000 for the purpose of building the new Brooklyn-Brighton bridge, has become a law.

A new $20,000 bridge is wanted at West Court street, Kankakee, Ill., and an effort is being made to secure the amount by subscription.

A committee of business men and taxpayers, of Dubuque, Iowa, are asking the council to construct a draw-bridge across the mouth of the ice harbor to connect with the roadway to the high bridge along the old levee. They claim that it is a better means of getting a new approach to the bridge than by extending Fourth street, which will cost $100,000 and the cost of the draw-bridge is estimated at $15,000.

Coon River at Eighteenth and Grand avenues, Des Moines, Ia., will be spanned by a new bridge. The approach or apron will be 248 feet long while the bridge proper will be 738 feet long.

A new bridge will be constructed across the gorge at Niagara Falls either by the Railway Suspension Bridge Company or the Grand Trunk Railway Company. The proposition of the bridge company is to construct a double-track bridge lower down the gorge, with a roadway for electric cars and carriages, besides footpaths for pedestrians.

Perhaps the most remarkable electric street railway bridge in the country, its roadway being 155 feet high and 850 feet long, or twenty feet higher than the roadway of the Brooklyn bridge, was formally opened by moonlight at Pittsburgh last night. It spans Jack's run, and lets the Pleasant Valley electric street cars from Pittsburgh and Alleghany into Bellevue and Avalon, and later to Sewickly, along the hills and banks of the Ohio river.

The board of supervisors of Sonoma county, Cal., will receive bids until May 4th, 1893, for the construction of a wagon bridge across Russian river near the city of Healdsburg, together with plans, specifications, working details and strain sheets, bridge to be 400 feet in length, of two or three spans, and 18 feet roadway. Bids will be considered for both a steel and iron bridge and a combination truss bridge.

R. B. Dennis, city clerk of Des Moines, Iowa, writes that the following bids for bridges have been received by the board of public works: A. M. Raum, $66,000; St. Louis Bridge Company, $65,980; Fair, Williams & Co., $64,775; Missouri Valley Bridge Company, $63,500; Kansas City Bridge Company, $62,578; R. D. Wharton & Co., $61,000; Canton Bridge Company, $59,600; Wisconsin Bridge Company, $59,380; Youngstown Bridge Company, $58,700; Variety Iron Works, $57,700; Wrought Iron Bridge Company, $56,996; St. Joseph Iron Bridge Company, $55,300; Toledo Iron Bridge Company, $54,873; Massillon Bridge Company, $49,990; George E. King Bridge Company, $48,970; King Bridge and Manufacturing Company, $48,000.

STREET LIGHTING.

Algona, Ia., is discussing the question of electric lights.

Huntington Valley, Pa., is discussing the electric light question.

Frankfort, Mich., is agitating the question of operating an electric light plant.

The question of street lighting by electricity is being discussed at Bradford, Pa.

The DePere, Wis., council has granted a franchise to an electric light company for a period of ten years.

The clerk of Newark, Ohio, has been instructed to advertise for bids for the construction of an electric light plant.

The citizens of the southeast district of Portland, Ore., recently taken into the city by the new charter, are discussing the electric street lighting question.

W. H. Wilmot, city clerk of Lambertville, N. J., writes that the Lambertville Electric Light, Heat and Power Co. are preparing to erect a plant at an early date.

Electric plants for street lighting purposes are to be erected at Caldwell, Ohio, Carrollton, Ind., Charlevoix, Mich., Fargo, N. D., Lancaster, N. H., Manchester, Conn., Newark, Ohio, and Warrensburg, N. Y.

Geo. H. Fister, city clerk of Elkhart, Ind., writes that on April 5 proposals will be received for fifty or more electric lights to burn all night and every night. Lights are to be located over the center of the street, not less than thirty feet high and at every alternate square.

S. H. Finley, city engineer of Santa Ana, Cal., writes that the water-works erected by that city two years ago has proved such a grand success that the board of trustees are contemplating putting in an electric light plant in connection with it, and will probably, in the near future, advertise for bids for that purpose.

A street-lighting ordinance in Omaha, Neb., provides for the placing of forty-four 2,000 candle power arc lights at that many railway and street intersections. The ordinance provides that the different railway companies shall pay for the rental for all lights placed at the intersections along their respective lines.

H. M. Miles, of Michigan City, Ind., writes that the Lake City's Electric Railway Co. has been awarded the contract to light the city and will construct a combination plant. The contract for the same has been let to the General Electric Co., of Chicago, for $225,000. The contract price per lamp for lighting the city is $75 per year for lamps burning until midnight, and for each hour after midnight 50 cents per lamp per month. Arc lamps per month, $8.

PUBLIC PARKS.

The old cemetery site, Laporte, Ind., will be transformed into a city park.

Seattle, Wash., is to have a public park on the shore of Lake Washington.

The city of Great Falls, Mont., has at its disposal $40,000 for the purchase of parks.

A new park bill provides for the division of Kansas City into two or more park districts and the establishment of one park in each district. The cost of the parks shall be paid by special assessments on the property in the respective districts.

The city council of Uvalde, Texas, has passed an ordinance directing that Fountain plaza be planted with trees and grass and that a fountain be erected thereon. Provision has also been made for the maintenance of such improvements.

The park board of St. Paul, Minn., has appropriated $2,030 for the purchase of the Minnetonka dredge and $6,000 for dredging Powder Horn Lake. The report of the finance committee showed estimated receipts of $255,355 for the coming year. Of this amount $52,418 is reserved for improvements, distributed equitably among the different parks. Loring Park will get $7,000; the Kenwood parkway, $3,500; Lake of the Isles, $3,000; Minnehaha Park, $3,000, and $2,500 will be expended for boats at Lake Harriet.

STREET RAILWAYS.

R. W. Havens, of Dallas, Texas, writes that the Electric Railway Co. has begun work and expect to have the road completed by July 31.

The Kalamazoo (Mich.) Electric Co. will furnish the power for the street railway company. Four one hundred horse power generators will be put in.

U. G. Scheffler, of Pen Argyl, Pa., writes that there is a movement on foot to build an electric railway from the Delaware Water Gap to Pen Argyl. Address for information, G. B. Reum, Sunbury, Pa.

A new ordinance in Covington, Ky., compels the street car company to have each car provided with a jack-screw. The ordinance imposes a penalty of not less than $50 for any car not supplied with the hydraulic lifter.

J. C. Kuhlman, city clerk of Wausau, Wis., writes that the city council has granted a franchise for an electric street railway to Messrs. B. E. Jones, Walt. Alexander, H. Dunfield and J. D. Ross. The line of road is to be about four miles long and work thereon must be commenced on or before June 1, 1893, and must be completed within eighteen months from the date of the franchise.

SOME LEADING ARTICLES IN RECENT NUMBERS OF PAVING AND MUNICIPAL ENGINEERING.

JANUARY, 1893.

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